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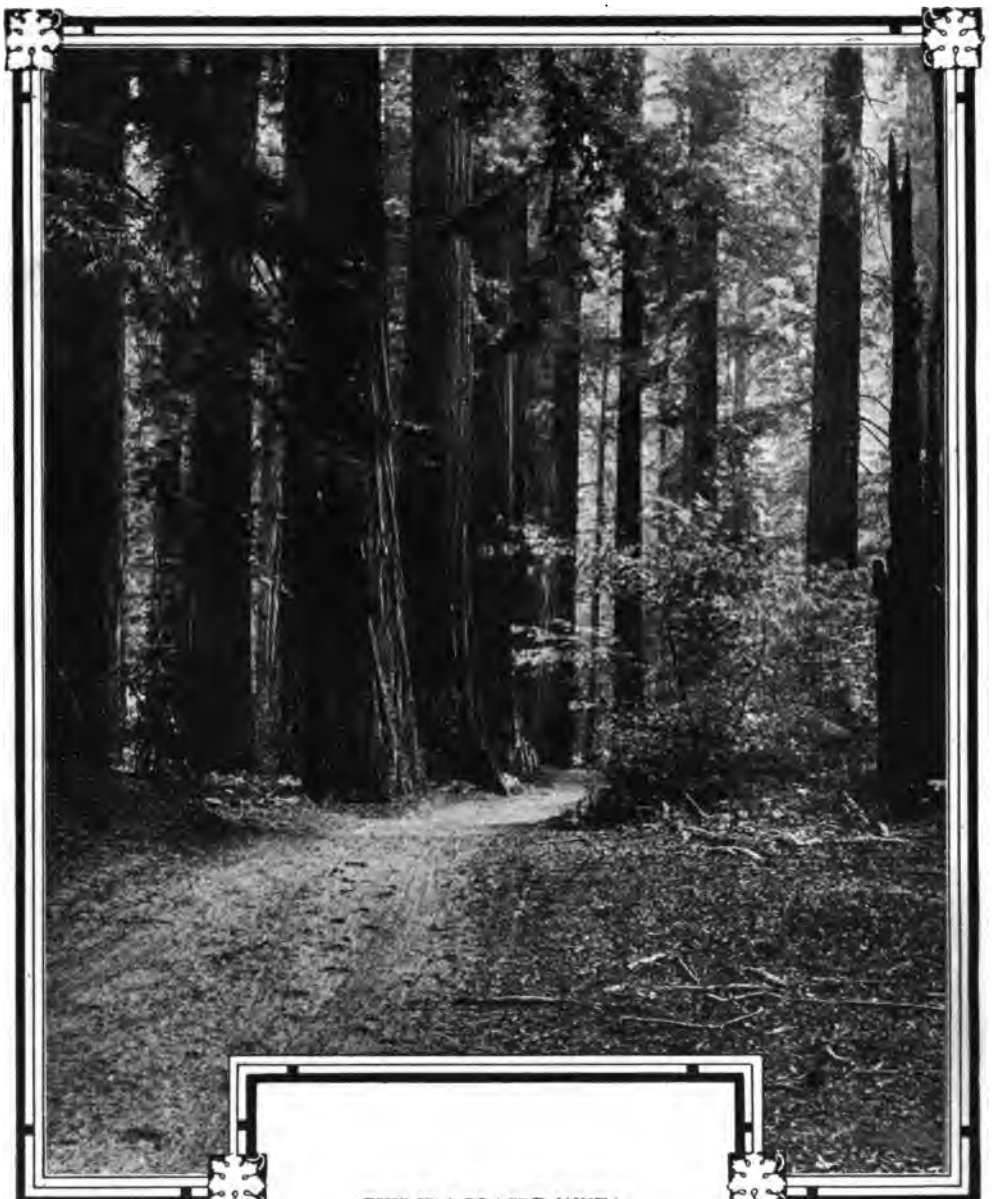

THIS IS A PLACER MINE!

A grove of California redwoods. Hundreds of thousands of acres of this sort of timber are held under old placer-mining claims. It is to perpetuate just such evil conditions as this that the anti-Conservationists oppose the land policy of Roosevelt and Pinchot.

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THE TECHNICAL WORLD MAGAZINE

Volume XIII MARCH, 1910 Number 1

SHALL THE LAND LOOTERS ESCAPE?

By AGNES C. LAUT

The Congressional investigation into the great fight between Secretary Ballinger and former Chief Forester Pinchot lends immediate and vital interest to this article. Miss Laut gathered the material for it at first hand, talking, personally, with the people interested in both sides of the fight. The most important question before the public, today, is this of preserving the remnant of the public lands from spoliation at the hands of predatory corporations, many of which make no pretense of observing the forms of law. In all this fight Gifford Pinchot has been the fearless and disinterested champion of the people.—*The Editors.*

ONE of the striking things you encounter traveling over the West is the fact that Conservation is no longer regarded as mere "conversation." It is a fact—the liveliest kind of a fact. It is no longer politics. It is a fight—the kind of a fight that splits the old party lines and leaves your professional politician dazed with one policy one day and a reverse policy the next.

Ask one man what Conservation is; and he tells you it is a kid-glove fad. Ask the next man; and he tells you it is a job for the iron hand of the law inside the kid glove—that from being a drawing room fad—Conservation has become a life and death struggle out in the open for right or wrong; that, in fact, one man was shot to death over it, with a "hung up" jury that refused to convict and ought to have been hanged.

It is an impracticable scheme to keep the settler from developing natural resources—says one side. It is a rallying cry to keep the predatory interests from fencing natural resources off from the settler—says the other side. What are the facts? Has anybody tried to fence natural resources off from the average citizen? What is all this vague talk about land loot? Who is doing the looting? What are they looting? Where and how?

Nobody denies that every citizen over twenty-one years of age has a right to a hundred and sixty acres of free homestead as long as the free land lasts, and three hundred and twenty acres of desert land, and one hundred and sixty acres of coal land at the legal price, or six hundred and forty acres if he has $5,000 to expend on them as long as the land lasts and will go round. On this, Conservationists and Anti-Conservationists are in perfect agreement.

The point is—if one man wants 260,000 acres of free land—which was what Mr. Yard of Plumas County, California, tried to obtain—is he to get it? If one company wants not 320 acres of coal land, but 50,000 acres at $2.50 an acre under the Timber and Stone Act, worth on the market $45,000 an acre—as

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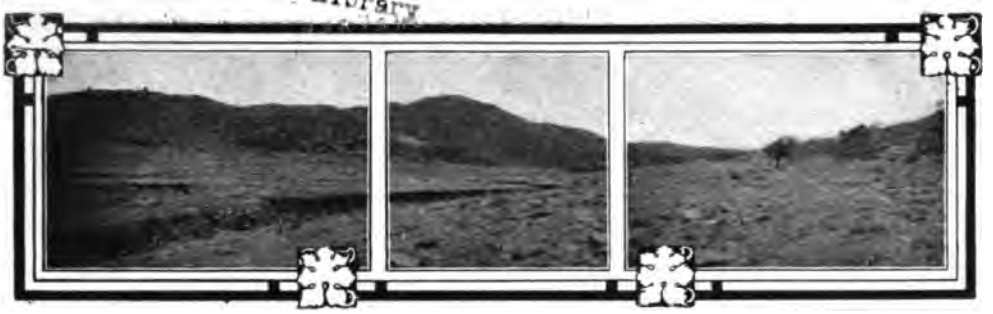


WHERE'S THE TIMBER?
Coal lands entered as timber lands.

the Colorado Iron and Fuel Company obtained big holdings—wants this land from the Public Domain, legally if possible but if impossible, then illegally—is the company to be permitted to get it? In the early days when there was no local traffic, it was the will of the settlers and the wisdom of Congress that the railroads should be granted non-mineral lands to enable them to build into sparsely settled districts; but the point is—are they, under this act, to patent—as the Southern Pacific tried to patent—thousands and hundreds of thousands of acres of mineral lands, to the eviction of old miners, who have been making a living on those lands for thirty years? Having taken illegal possession of certain coal lands—as one company did in Southern Colorado—are they to be allowed to shoot down in cold blood the Federal officer sent from Washington? It was the wisdom of Congress that the humblest citizen who could scrape money together should be facilitated in buying coal lands; but are big companies to be

AT THIS SHAFT A FEDERAL OFFICER WAS SHOT AND KILLED.
This claim, over-grown with scrub oak—really valuable coal lands—was illegally entered.

allowed to bring humble citizens in by the train load, "dummies" paid $100 to $300 each, to file on coal lands for the big corporations? And having obtained hundreds of thousands of acres of coal lands—as one big smelting company has obtained them—are they to be left undisturbed in possession of their illegal holdings? It was the wisdom of Congress that the settler should have free access for his personal use to the National forests; but the point is—are the big companies under cover of that settler's right to be allowed to send that settler in to take (steal?) hundreds of thousands of feet of lumber every year from the National forests, as one big smelting company of Montana did? These are but a few—a very few—of the questions that have put the Conservationists and the Anti-Conservationists at daggers drawn, and have torn party lines to tatters all through the West and the Middle West. These are the real points that the Senate must either smother or uncover in the investigation which has been undertaken.

When the story comes to be written a hundred years from today, it will read not unlike a tale of the old time free booters, who found their backers among the mighty, chose their servants from the lowly and set off through the wilderness to take what they might find.

Take the case of the Colorado Fuel and Iron Company now owned by financiers of the Standard Oil. Before the Standard Oil took hold, the Colorado Company had obtained 50,000 acres of coal land through dummy entries; that is—a man and his wife and his children sold their scrip on perjured affidavits that this was worthless stone and timber land nominally valued at $2.50 an acre. According to the story told me by the Federal officer investigating the matter, none of the dummies was paid more than $300 and some were paid less than $100 for acting as homesteaders of this land. If purchased legally, it would have cost $20 an acre; and the land is today bonded at $150 an acre. Once, at a law suit, one of the company's engineers testified that as much as 15,000 tons of coke coal might be taken from one acre. This coal is worth $3.50 a ton and should have yielded the government five cents a ton or $750 an acre. Instead, the government got exactly $2.50 an acre; and the royalty of five cents a ton or $750 an

WHEN LAND OF THIS CHARACTER IS PATENTED FOR HOMESTEAD PURPOSES—LOOK OUT!

acre was lost to the government and to the people, who are the owners of the Public Domain. The Colorado Company was formerly owned by the Gould interests; and it was a well known promoter of Denver that engineered the dummies. Two-fifths of these 50,000 acres were obtained within the last fifteen years; but the Statute of Limitations bars action for restitution of the major portion. About 10,000 acres were entered within the last few years; and action is being instituted by the Department of the Interior for the recovery of this amount. Whether the action will be pushed through or allowed to dawdle till the Statute of Limitations bars this, too,—remains to be seen. At the bonded value, the loss to the Public Domain is $7,500,000; at royalty value, $37,500,000.

It isn't hard to see the line of cleavage between the Conservationists and the Anti-Conservationists in this case. It is no longer a question of politics—it is a question of theft from the Public Domain.

Down at Durango, Colorado, is almost a similar story in connection with the Union Pacific Coal Company, a subsidiary corporation to the railway. John A. Porter, as geologist and engineer, is credited with locating the coal field. No one would grudge the locator a good big reward for his find; but when that reward ran to 20,000 acres obtained by promoters at less than $5 an acre in ways not recognized by the coal laws of the land, and passed immediately to the Union Pacific Coal Company for a consideration of $1,250,000—the public began to ask about the $800 an acre royalty, which should have enriched the

LOGS OF BIG TREE BLASTED WITH GUNPOWDER FOR EASIER HANDLING.
Not only is much of the tree wasted because of irregular shapes of the huge sections thus produced, but too often the wood itself is shattered into splinters.

CUTTING UP THE FALLEN GIANT.

public treasury; and action was instituted for recovery. One J. A. Walker, a government investigator, with several others, had walked across to the air shaft of the mine one Sunday to inspect the exact size of the coal veins. While the other officers went down the shaft, Walker remained at the top on guard. When the others were ready to come up, they found the rope of the hoist had been cut. Some premonition of foul play spurred their suspicions and one man succeeded in clambering up the sheer sides of the shaft. On reaching the surface, he found what discounts the crimes of sensationalism or fiction—Walker lay weltering in his blood, shot to death in broad day light by some of the mining men standing on either side of the corpse. Two men were tried for the crime in the state courts; but the evidence was only circumstantial, and the power that was potent to dare theft from the Public Domain was equally potent in the jury room. The verdict was acquittal. An indictment for conspiracy has since been obtained in the Federal courts; but when you come to investigate land loot in the West, you find indictments plentiful as June chickens, convictions scarce as hens' teeth.

Here, too, the line of cleavage between Conservation and Anti-Conservation is sharp as the line between right and wrong, between law and crime. The Federal government sells coal lands at from $10 to $20 an acre up to 160 acres; and will permit the holder 640 acres if $5,000 of development work be done; but it will not permit big companies to grab all coal areas under cover of dummy entrymen imported by the carload. The state sells coal lands on a royalty basis that should bring back to the many some slight returns for the enormous profits to the few. Whether the coal lands be under Federal or state control, the dummies who immediately sign over to the

A SAMPLE OF GOVERNMENT COAL LAND SECURED FOR $2.50 AN ACRE. This is on a claim illegally taken up as timber and stone land.

big holding companies have violated the law; and the employers of the dummies have violated the law. The question at issue is whether in the name of development, violators of law and murderers are to go unpunished. You see now why Conservation is no longer a thing up in air, but a fight, and a hard one, and a long one. Congress has set aside $1,000,000 for a field force to investigate land frauds and protect public lands. Probably $50,000,000 worth of lands have been restored to the country; but if when investigation leads too close to government men, it is called off, or smothered, or held over for the Statute of Limitations to work; or if when investigators enthusiastic for right are dismissed from the service for persisting in rooting out fraud as Glavis at Seattle and Pollard at Portland were dismissed—it is a question whether the so-called investigation will not lead to greater abuse of favoritism than the old-fashioned free-for-all grab.

"Why, we have uncovered cases here," said a Federal judge of the West to me, "where some poor foreigner has gone in with his wife and all his children and filed affidavits of which he did not know the meaning, false as to date of entry, false as to age, false as to character of the homestead, and gone away the richer at $50 a head after signing everything to some promoter, who was working for a big company. It was the universal thing here a few years ago. Nobody thought anything about it. Nobody asked awkward questions and everybody smiled. Dozens of indictments have been returned for coal land frauds in Wyoming and Colorado." (One indictment is against a judge, though this Federal judge did not tell me so.) "We have reclaimed 10,000 acres in Colorado; and probably 30,000 will be reclaimed."

Thus investigation has been followed by some successful suits.

Down in Nevada, the land loot was perpetrated through old land grants to the old Central Pacific. When the Central Pacific was built, there was practically no possible revenue between terminal points east and west of Nevada. Huntington and his associates had to have land grants as a basis for their bonds. Even then, New York bankers asked derisively why they were building a road where there was no traffic between terminal points; to which Huntington retorted, why did Atlantic liners

run where there was no traffic between terminal points. So the Central Pacific had to have land grants. To it, were granted in 1862 or thereabouts, every odd section in every township for twenty miles on each side the right-of-way; but the law specially and specifically provided that "no mineral lands should be included by the railway company;" and the Huntington crowd adhered to the spirit of that law till the Harriman control came in. Then, the railway began patenting its lands wholesale. Within seven years, more than 2,000,000 acres were applied for patents under the old Central Pacific grant. Of these two million acres, three hundred thousand acres were openly known to possess gold, silver and copper deposits. Suit was instituted by the Federal government at Carson City against the Central and Southern Pacific for 75,000 acres that the railways had patented as non-mineral; and at the suit—which by the way, not a dozen papers in the United States reported—it was brought out that much of this land had been producing gold and silver for thirty years. Patent had been secured by advertising in papers of small local circulation and by making affidavit that the lands were non-mineral. Representatives of the roads had gone to the miners with the advice "keep quiet; we'll not hurt you, we'll work together;" and in that way, the title to 75,000 acres, on which miners had been working for thirty years, some claims valued at $1,000,000 — passed to the railway. Deadly easy claim jumping, was it not? And do you suppose the old prospectors would have been left in possession any more than the prospectors at Nome, when the land looters began their manipulation there? But at this stage in Nevada, the Federal government got busy. Seventy-five thousand acres were restored; and unless some unseen influence intervenes, suit will be instituted for 150,000 acres more. The areas involved in this land looting exceed many times over the areas involved in the pillage by robber barons of old; and this pillage is done under sanction of democracy and under cover of law, Again, Conservation becomes a mighty vital and real thing.

An unseen influence sometimes intervenes to the clogging of the wheels of justice. In fact, so clogged have the wheels of justice become in one or two cases, that they have stopped going round altogether and they have stayed stopped till the Statute of Limitations had intervened when—whizz like a buzz saw, they began going again; but of course, the Statute of Limitations had removed the case from reach of the wheels of justice. All this, apropos of a case which every land investigator in the West knows and nobody talks about; for it is no longer permitted that such facts be given the public whose Public Do-

DO THESE BLEAK PRAIRIES LOOK LIKE TIMBER LANDS?
Yet they have been entered as such, contrary to law.

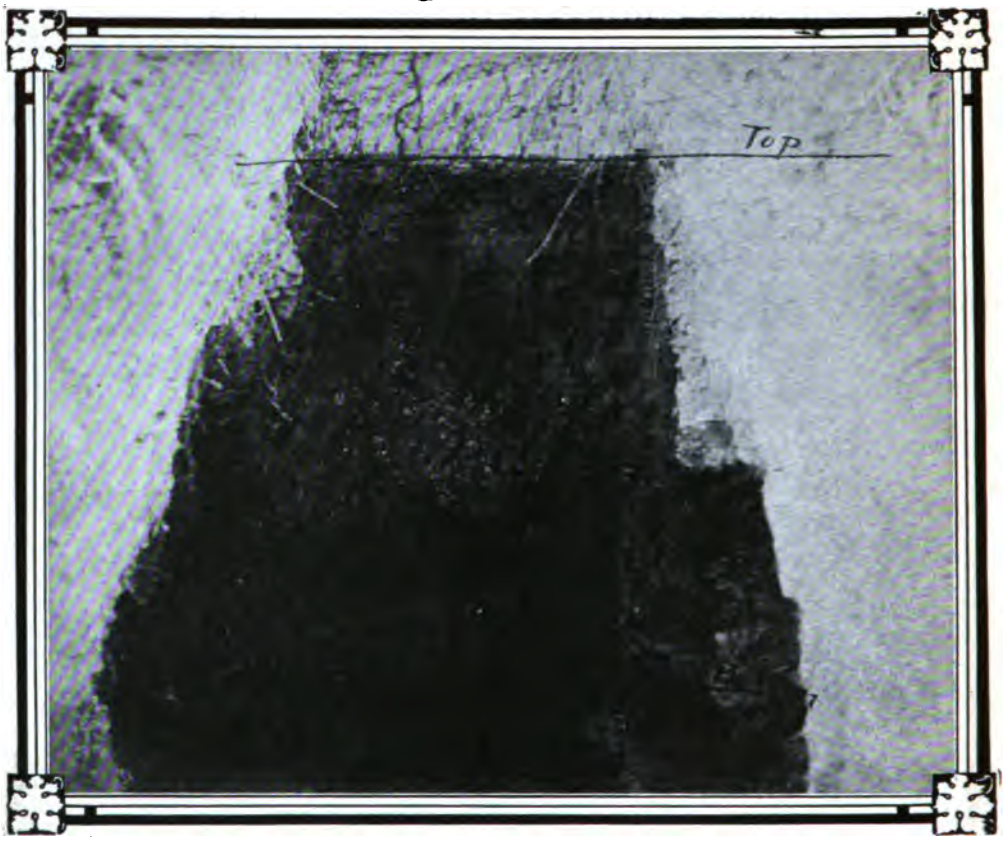
A FIRE PRODUCED BY RECKLESS FORESTRY.
Scene in Rosebud County, Montana.

MECHANICAL CONTRIVANCES ARE NOT LACKING IN THE LOOTING OF OUR FORESTS.
A logging train in California.

main is in danger. It is a well known fact in Colorado and Nevada and California that one of the largest smelters in the West is located almost on top of a coking coal area of 2,000 acres, obtained at $2.50 an acre as desert lands through dummies paid by the attorneys of the smelting company; but that was nine years ago. Though the land office men knew of the dummy business, action for cancellation of fraudulent patents was not begun till it was too late to begin. Now the question is—should the government institute suit for damages? Again, Conservation becomes a very practical thing and not a kid-glove affair at all. You understand now why the very word Conservation calls down a storm of abuse from certain quarters. The kid-glove theory has become, in fact, a thing that may mean restitution. If space permitted the story of the Alaskan railways, there would be another story of violence and murder, to be sure only the murder of poor foreign navvies nerved up by whiskey but still—murder. Meanwhile, the Nevada state legislature which is Democratic has passed a unanimous vote of thanks to the Department of the Interior for saving the mineral lands. It remains to be seen what will be done about those smelting coal lands.

SEVEN-FOOT COAL VEIN ON A TIMBER AND STONE CLAIM.
The claimant gets this land from the government for $2.50 an acre. It is worth $150 for coal mining purposes.

The stealing of the timber lands is the most accomplished work among the land looters of the West today. Any man, who could invent a new way to do it, would be paid a royalty by the land looters for his idea. To begin with—don't measure the value of timber lands in the Pacific Northwest by anything the East has ever known, or, for that matter, by anything the world has ever known. There is greater demand for lumber today than ever before; and lumber is scarcer than ever before. Best of all for the lumber men, prices are higher than ever before. Then consider the enormous girth, the enormous height, of these Pacific Northwest trees; and they grow closer than ever the Eastern hardwood forests grew. Think what it means—a single California redwood or a single Douglas fir or a single spruce supplies sufficient lumber to build a cottage of six rooms. Some of this lumber runs 300,000 feet to the acre, worth from $2 to $3 per M on the stump. A single quarter section has been known



MORE COAL DEPOSITS.
The Federal government is now trying to recover such lands as these.

to run 20,000,000 feet. Quarter sections have yielded net $20,000, $30,000 and more; but don't run away with the idea that the homesteader took in those returns. He didn't! A forest yielding those high returns is hard to conquer as adamant. The individual man might as well tackle the eternal rocks with a file as these trees with his individual muscle. They require gangs of muscle and strong machinery and whole trains of flat cars—not bob-sleighs and wagons—to haul them to market. Your homesteader who finds himself in this kind of a forest must either sell out to the big operator, or find himself in prison in a wilderness of wood, where his own unaided effort can never hew out roads and trails.

The prize quarter sections of the big timber country proved a stronger magnet to the land looter than gold or coal. It was so easy to get the dummy, then act as middleman towards the big operator; and often, the looters did not even bother with a dummy. In Montana, the land loot very largely took the form of what is politely called "timber trespass." The big smelting companies use enormous quantities of timber. To obtain this, it was customary for them to contract with the small mill men and homesteaders to deliver so many million feet a year. Nothing wrong in that contract—was there? But the small mill men and homesteaders would sit down on their own 160 acres, then instead of cutting from their own area, they cut all around outside, and delivered this stolen timber to the smelting company. The smelting company knew perfectly well what was being done, for they inserted in their contracts a clause providing they should not be liable to suits arising from the areas so cut. Roosevelt put a stop to this free-for-all grab by including these areas in the National forests, and in

spite of the saving clause, the smelting company has been compelled to pay a quarter of a million damages a year for these timber thefts.

Down in Colorado, the theft was worked slightly differently. The law allowed the homesteader to take windfall and dead timber from the Public Domain free; so the mill man would sit down on his homestead, set fire to a whole mountain slope of green timber, then saw himself into a millionaire from the timber killed by the fire which he had set. Stop was put to this profitable business, too, by including forested areas of the Public Domain in the National forest. In these two cases, Conservation becomes a very live sort of thing—a thing to be hated by the looters of the timber lands.

In certain areas of California, it is almost impossible to take washings from sand bars in any stream without finding minute particles of mineral. Whether the mineral is in paying quantities or not, does not matter in the least. The finding of the specks constitutes a placer; so the land looter places blanket placer filings over the most valuable timbered areas. Over 260,000 acres of the most valuable timber in Plumas County were held on such titles. The case is now before the Department of the Interior. Think what this means! Suppose each 160 acres of this area is worth the minimum of $10,000. On placer title, there has been quietly appropriated from Public Domain $18,000,000 of timber. Here, too, Conservation is no longer a merely academic thing. It is a standard of right *versus* wrong. Round that standard, the fight must rally; and perhaps the hardest fight of all is not for the thing itself, but against the forces of slander and misrepresentation. If such titles as those placer claims were allowed to stand—the public would be literally fenced off 260,000 acres of its own by the theft.

Down in Oregon, they have looted the

WHEN THE LAND LOOTERS HAVE PASSED.

A MONARCH AS OLD AS METHUSELAH.
Sixty feet from the stump this monster measured sixteen feet in diameter.

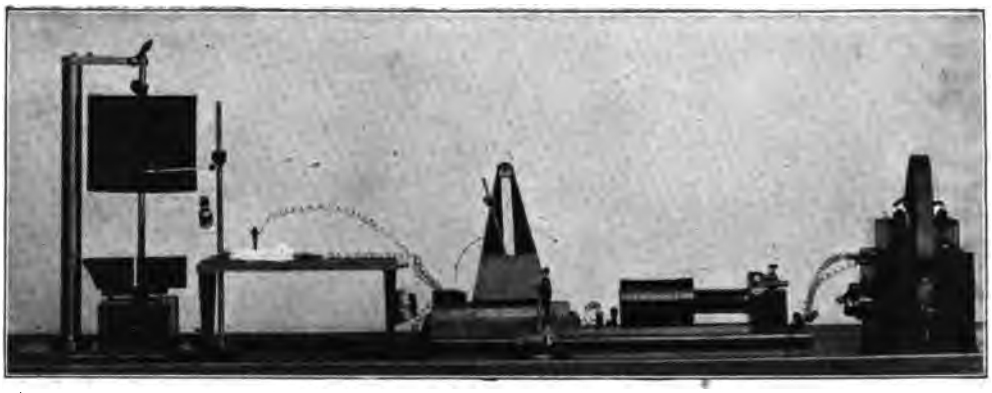
public land in the name of roads, in the name of schools, in the name of Indian reserves, with a detail of manipulation which space forbids telling. Just one example—if you examine a public highway map of Oregon, you will see three broad ribbons in red running across the state diagonally from northwest to southeast. They represent land grants of 2,000,000 acres in all for the construction of roads upon which work was never actually done. How was the trick rigged? Why the governor and his commissioners years ago loaded a buck board with champagne and chicken pie, drove a few miles out from the little frontier posts where the road was supposed to begin, had a picnic, and returned to the fort with the report the road had been built and they had formally inspected it. The thing was a howling joke to Oregon. It would have taken that governor not days but months to traverse the wild country of a so-called road; and the roads have not been built to this day; but the land was patented and sold by the land looters to outside investors.

And the looting is not all in the past. It is going right on today in spite of National forests and Conservation; and it is going on under the cover of the law. As every one knows, land that is arable is open to homesteading in the National forests. No genuine homesteader is ever rejected; but who is to tell what is a genuine homesteader? Up in Washington, quarter sections of timber run in value all the way from $10,000 to $40,000. Your homesteader comes in and wants to locate a farm of heavy timber at a slant of an angle of 45 degrees. As a farm, this is ridiculous. As a timber chute, the location is perfect; but the man swears he wants that farm though it will take $300 an acre to clear it and the man hasn't 300 cents to his name. If the homesteader's application is rejected, some senator arises in his wrath at Washington and champions the rights of the poor settler—the citizen of this free-for-all republic. What he doesn't tell is—soon as this poor, poor settler of this free-for-all republic got his patent, he sold out at a song to some big lumbering company. What he doesn't tell is—that particular location acts as a cork up the entire canyon for all other locators, who must either stay corked or sell to the big interests at any price named. Hundreds, thousands, hundreds of thousands

HOME-STEADER'S CLEARING IN THE FOREST OF WASHINGTON.
Such clearings are made merely to satisfy the letter of the law. The land usually passes nto the hands of timber companies.

of acres of priceless timber have been so obtained by the big interests in California, in Oregon, in Washington. One big Minneapolis firm alone obtained in California and Oregon 500,000 acres through dummy entrymen. Another obtained 100,000 acres. These facts are known to every field officer. Why are the thefts not punished, as the theft of a scuttle of coal or a cord of wood by a poor man would be punished? Echo answers—why? Why was Glavis dismissed for trying to stop a coal grab in Alaska? Why was Pollard dismissed for being Glavis' confidential man? Why were Glavis' two stenographers hurriedly transferred from Seattle to Montana on pain of dismissal if they did not instantly report at the distant post? (I read the order sent to one of these stenographers, though she did not know it.) Echo answers—why?

What does it all mean? It means Conservation *versus* Anti-Conservation. The thing is no longer academic. It is now a fight, with both sides arrayed, arrayed in Congress, arrayed in Senate, arrayed in petty local politics; and strange as it may be to acknowledge it—it is a question which side will win. That can be decided only by the public. With which side will the public line up?



TAKING THE FATIGUE RECORD OF A MOUSE.
The animal lies on the small platform at the left. Under spur of electrical current, controlled by the metronome, he exerts periodic pulls that are recorded on the board above.

SURGEON'S NEEDLE CURES FATIGUE

By H. G. HUNTING

THERE is a wonderful, rapturous vision of perfect life in an ideal future, which Mr. Kipling has put into a poem. One of its phrases is "We shall paint for an age at a sitting and never grow tired at all." And whether we paint or write rapturous verses about it, or do something that is very much more prosaic, for a living, there isn't one of us who doesn't get a thrill out of that idea of never getting tired over it. Of course, Mr. Kipling doesn't believe that such a thing can happen to humans during their sojourn on this planet and he doesn't raise any immediate false hopes. Though men have had visions and dreamed dreams about that delectable condition, ever since Adam's hairy wrists grew weary with his first tilling outside the garden.

But the Germans were ever a hardy people. They have their poets also, and they paint, but some of their entirely prosaic, materialistic scientists occasionally dare as much as artists or bards in the way of breaking into prophecy. Such a one is young Dr. W. Weichardt, private lecturer at the University of Erlangen, who says he has discovered the real nature of fatigue and has a cure for it that is going to put an end to that tired feeling, for good.

Of course he begins with a germ. That's were all things medical and some things moral are believed nowadays to get their start. He knew that nearly all if not quite the whole number of diseases are produced in our unsuspecting tissues by the entirely selfish business and social pursuits of one or another thoughtless microbe. He also knew—and now has learned a good deal more about it—that whenever a spirited member of the microbe family gets very busy he produces a poison in his immediate neighborhood that makes a lot of trouble till the organism produces an antidote or antitoxin to counteract it. So far, he was not ahead of the men who discovered the diphtheria and typhoid fever

APPARATUS FOR DETERMINING THE QUANTITY OF POISON IN AIR EXHALED BY MICE.

antitoxins. But he has ventured to announce that the condition which we describe variously as fatigue, weariness, exhaustion or just plain tiredoutness, is likewise due to a toxin, which has—oh welcome hope—its anti, too, and one that is available for use.

Fatigue, then, partakes of the nature of a disease, being itself due to a toxin. Just as in all other cases where such a toxin is produced, there is created, side by side with it, in the human body affected, the antidote, a spontaneous product of nature from materials that she has always in her laboratory. The antidote, if plentiful enough, will counteract the poison and restore the sick body to health. If more than plentiful enough it more than counteracts the poison it fights and becomes a tonic, a sustaining substance that raises the efficiency of the body above that which we are accustomed to consider normal. The experimenter deduced this from the fact that in repeating a given physical exercise, after an interval of rest, the body shows greater capacity than in initial effort, indicating that there has been an overproduction, for the moment, of the antidote to fatigue caused by the first exercise of the muscles, and that it has become a stimulant.

THE PROTECTIVE EFFECTS OF ANTI-FATIGUE SERUM. Both mice have been inoculated with fatigue poisons. The alert animal was previously injected with the serum; the other—almost asleep—was not.

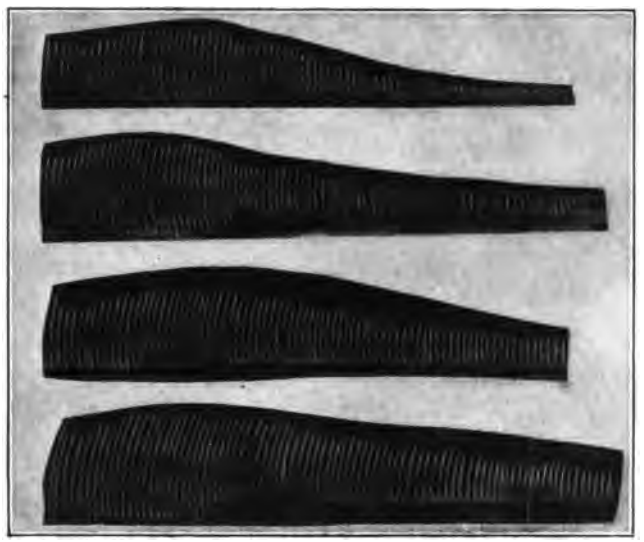
Dr. Weichardt first recovered the supposed poisons of fatigue from the muscles of animals exhausted by weariness. A difficult technical process was necessary to this end, but accomplished its purpose, after considerable experiment. Obtaining finally a highly active substance in crystal form, he found that he could produce a genuine fatigue in creatures inoculated with it. Even death was brought about in some cases by means of such inoculation. By injecting, then, the serum of animals treated with the fatigue toxin into the blood of other animals he found that the latter acquired a surprising faculty of resisting fatigue, and, even when doses of the fatigue toxin, which would have been fatal to the unprotected animal, were administered to those so treated with serum, they showed little or no injury as a result.

It was simply a matter of aiding—or rather of anticipating Nature. When white mice were given daily doses of fatigue toxin, they suffered at first, considerably. After a time, however, they began to gain strength and resisting power, proving, according to the scientist, that the spontaneous production of the anti-toxin within their circulation was superabundant for the counteraction of the toxin injections. When the serum obtained from other animals was immediately introduced after injections of the fatigue toxin, the effect was exactly similar. The reasoning was therefore simple, which led to the anticipation of fatigue by the injection of the anti-toxin, and the results seem amazingly to carry out the scientist's hopes.

The protective effects produced by the injection of anti-toxin are seen in one of the illustrations. Two mice were treated with the same amounts of poison. The upper one in the photograph had been inoculated with the anti-fatigue serum previous to the experiment, and did not show any sign of fatigue. Its companion presented all the symptoms of extreme exhaustion, was almost asleep. with its hair standing on end, eyes closed, and a respiration greatly slackened,

while the temperature of its body also dropped several degrees.

The experiment shown in the illustration at the head of the article followed this. On a small platform in the left hand part of the picture is seen a white mouse, connected with an electric



FATIGUE RECORD OF A MOUSE.
The top record was taken first. Note diminishing length of lines from left to right, showing growing fatigue. The second and third were taken after periods of rest, and indicate increase of strength due to formation of natural fatigue anti-toxin. The fourth record was made after injection of artificial anti-toxin. The effect is apparent.

circuit through which periodical current impulses are thrown by a metronome, at the rate of one per second. These impulses cause the mouse to exert a rhythmical pull by which the weight attached to its feet is lifted a certain distance. The extent of these movements measuring the strength of the animal, was registered on the plate visible at the extreme left. The photo on this page contains some sets of curves thus obtained, each showing the gradually decreasing performance of the animal. Whenever the experiment was resumed after rest, the curves are seen to have undergone a striking increase, thus indicating the invigorating effects of the spontaneously produced anti-poison, in its body. More powerful effects were those obtained by inoculating the mouse with the artificial anti-toxin.

Dr. Weichardt has discovered, also, in this connection, that the air expired by man and animals contains the same poison to which the production of fatigue is due. The objectionable properties of vitiated air are generally ascribed to the carbonic acid contained in it. It has been shown that as high as one part of carbonic acid in a hundred parts of air will exert no detrimental action in the human body. This appeared to show the existence of some virulent poison breathed out continually from the lungs, but all the attempts formerly made to isolate this hypothetic substance were utterly unsuccessful. Dr. Weichardt used another arrangement of apparatus to settle the problem.

The animal to be experimented upon, a mouse or a guinea pig, was placed in an air-tight vessel, communicating with a tube for air supply which was freed from any carbonic acid by means of different chemicals enclosed in it. On the other side of the vessel was arranged a tube for discharging the air expired.

The experimenter found the air expired by the animal to be contaminated with the same toxin, and determined its quantity by means of the apparatus represented in the lower illustration on page 20. He then inoculated some mice with toxin and found these to expire a far smaller amount of the impurity than animals submitted to no previous treatment.

It is inferred, among other conclusions, that when some part of our muscular system is submitted to normal training, no detrimental action on the part of the fatigue poison need be feared, as the production of anti-toxin brings about a salutary balance. If, however, the body, or part of it, be tired out to absolute exhaustion, the toxin is produced so abundantly as to destroy the capacity for production of the antidote, and a lasting diminution of strength, or, in extreme cases, even death, may then ensue. Athletes are well acquainted with the evil

effects of over training with its sudden decrease in vigor.

But the most important development in Dr. Weichardt's work was the artificial production of the poison and counter-poison of fatigue—or "kenotoxin" and "anti-kenotoxin" as they are called. Supposing these substances to be merely oxidation and reduction products of muscular albumen, he submitted solutions of animal albumen to the action of electric currents, hydrogen, peroxide, chlorine, colloidal, palladium, etc., and tested the biological effects of the residues thus obtained. Animals inoculated with these substances would undergo the same detrimental effects—suffocation, drop in temperature, torpor—as in case of a treatment with the natural toxin extracted from exhausted muscles. After having thus obtained the poison of fatigue by artificial means, the experimenter succeeded in producing the anti-toxin by a similar process, independent of any animal organism. The artificial stuff produced from albumen, in the form of either injection fluids or soluble powders, can now be obtained by anybody at a relatively low cost.

It is expected that the artificial antidote against fatigue will lend itself to many uses. A number of scientists are at present at work to ascertain the effects of the anti-toxin on the most varied maladies. Some have, for instance, obtained rather promising results in the treatment of tuberculosis, and in this connection, it will be interesting to note a fact discovered by Dr. Weichardt himself,—that the serum known as tuberculin, with which such good results have been obtained in many cases, contains besides the tuberculous virus proper, poison related to the very toxin of fatigue itself.

Extensive experiments go to show that animals treated with the antidotes offer much more resistance against the bacteria of a number of diseases than those left unprotected. This shows the extent to which the method is likely to prove of value in medical practice.

Another question will be whether the artificial antidote really is a means of increasing physical strength, enabling the body to do better work than without this treatment. To this is suggested an affirmative reply not only by the results of the experiments above described, but by a number of tests made by Dr. Weichardt both upon himself and upon other persons. Though further observations will be required to reach any definite judgment, it can doubtless be asserted that the artificial anti-toxin deserves the fullest attention of all those engaged in physical training. In fact a marked decrease in the feeling of exhaustion, and accordingly, a decided increase in vigor, is invariably produced by the treatment with this substance. The invigorating effects will continue about half a day or more following treatment, and leave no disagreeable after-effects. While the capacity for work is thus augmented, the want of sleep is reduced to some extent, but no nervous excitation is noted. In fact, as the antidote is a natural product of the body, it is free from those detrimental effects necessarily connected with foreign bodies introduced into the organism.

Whether it may be possible to extend these invigorating effects to the capacity for mental work will have to be ascertained by further experiment, though the information so far gained seems to point in this direction.

THE RUSH FOR FLORIDA

By WINTHROP PACKARD

"I WANT a million acres of land in the state of Florida, in a section running right across the state, from tide water on the east to tide water on the west." Such is the request which a New York capitalist made of the Land Department of the Florida East Coast Railway. The request was made in dead earnest and price was no object, yet the demand could not be filled, partly because the conditions were unusual, but more because land in Florida is already so well taken up that a location of such size was not to be had. Applications from people handling big capital and wishing an outlet for it in safe and good investment come daily to responsible parties here in the state. One sees advertisements for land in fifty or a hundred thousand acre tracts in the state almost daily in the principal Florida papers. The rush for land in Florida is surely on.

There are many reasons for this great and comparatively sudden demand. One reason is that the lumber and turpentine kings are beginning to release their grip on the state lands. Having turpentined the trees to death over vast tracts, and then cut them and sold the lumber, the land is useless for their purpose. This land, which cost the turpentine men from twenty-five cents to a dollar and a half an acre, they are now glad to sell in large lots, thirty to a hundred thousand acres, to land speculators at three to five dollars an acre. These divide their purchase into five and ten acre plats, advertise them as extraordinarily fertile, in a state where the climate is wonderfully favorable to agriculture, and sell them, to people who have never seen the state, at from fifteen to fifty dollars per acre. Land is to be had in quantity for the first time, for farming purposes, and the big real estate men who follow the world's map and the world's markets with ever vigilant eye are making a rush for it. Among them are many who, through the construction of roads, drainage ditches, demonstration farms and telephone systems, and through their intelligent aid and instruction to the new-comer are adding in measure the value represented by the difference in the price they have paid and the price they will receive for the land.

WILD FLORIDA LAND.
Cabbage palmetto trees, on the St. Lucie River.

"Colonies," literally by the score, are being planted all over the state, from Nassau County on the north to Dade and Lee on the south, a distance of about five hundred miles. In the very Everglades themselves, a section that our geographies once taught us was but

a vast swamp with little or no land above water, four or five land companies are operating and I find reports of sales something as follows during the past year. The Bolles Co. have sold about 10,000 farms in ten acre lots at $20 to $24 per acre. The Everglades Land Co. 2,000 farms at the same prices, the Everglades Plantation Co. 1,000 farms at $50 to $100 per acre, and the Everglades Land Sales Co. 1000 farms at $30 to $50 per acre. It is estimated that forty per cent of these sales are to actual settlers, the balance going to the small speculator who is willing to chance the investment of a few hundred dollars in the hope of a great increase in price of these lands later on—when they come out from under the water. For it is a fact that much of the Everglade land sold is at present to be traversed only in boats or in rubber boots. I think as a rule the buyers understand that. If they do not it is their own fault. It is a well-known fact that one big sale of Everglade land was by the state, a half million acres at $2 per acre, the state agreeing to put out one dollar per acre in draining this land, no time being set for the completion of the drainage contract. The state now has four $50,000 dredges at work and has so far dredged about 25 miles of canal and nine of river. Bids have just been received for 300 miles more of canal and optimists think the drainage of the lands sold may be completed in ten years.

As a sample of the rush on the part of the small speculator and small farmer for these Florida lands may be cited the cutting up of a big tract near Tampa about a year ago. This was advertised by a Jacksonville firm in one of the best known weeklies in the world and money came by mail for these five and ten acre lots from Honolulu, South Africa, Panama, Philippine Islands, Ceylon, in fact, from almost every country in the world, the whole tract being sold out almost immediately. Probably not one man in ten that invested from a hundred to a thousand dollars in this land saw it before purchasing, the reputation of the publication in which the advertisement was inserted being considered a sufficient guarantee of the transaction.

I have visited several of these sudden colonies and may select the one at Bunnell as typical of those which seem trying to give a square deal to the incomer. Bunnell is a little station on the East Coast Railroad, east of the St. Johns river and about a third of the way down the state. A year ago it was a turpentine station in the flat woods of Volusia County, just about squeezed dry of its turpentine and with the lumber pretty well cut off. Judicious advertising sold 28,000 acres of this land, which no longer had value to the lumber and turpentine people, for $20 to $50 per acre, in blocks of five, one man at least whom I saw on the place and who was well satisfied, buying 80 acres. The whole town was sold out in a few weeks. Adjoining the Bunnell colony the St. Johns Development Co. sold thirty thousand acres under similar circumstances in just five days. It is safe to say that nine out of ten of the people purchasing never saw the land until it was theirs, though the Bunnell people gave the purchaser ninety days in which to see his land and, if dissatisfied, get his money back at eight per cent interest.

On the West coast similar developments are in progress. Near Tampa the Pinellas Groves Company is colonizing a large tract on the Pinellas peninsula, most of the land being set out to grape fruit.

This enthusiasm as to the value of Florida soil has a broad and deep foundation in fact. Conditions in the state are such as may be found nowhere else in the Union. For five hundred miles the peninsula of sand, almost as level as a floor, practically without a rock, extends down toward the tropics with vast bodies of water on both sides of it. Winds from the great ocean temper its climate in the winter, and, though on some winters the northers drive freezing weather almost to Key West, the temperature in the main is such that, when all the rest of the country is frozen up, fruits and vegetables may be grown, at least in the southern half of the state, successfully. What the northern farmer does in January, painfully and with much cost in labor and coal under glass, the Florida farmer may do in the field. Portions of the land, moreover, are extraordinarily fertile, the sand and rich

humus being mixed to great depth in somewhat the same proportion as the careful florist mixes them for his carnation beds. Add to such a soil the proper fertilizer and the conditions for successful crops are theoretically perfect. As a matter of fact there are certain other conditions which enter into the matter, of which more will be said.

Orange and pineapple growing have been very successful in Florida for years and much has been written about them. Of late, winter truck growing has received a great impetus, some men having made small fortunes in a short time by it. Let us pass all these and come down to certain staple crops which all farmers understand. Such are Irish potatoes, field corn, and hay. It is just recently that the farmers are finding out what they can do with Irish potatoes in Florida. The region about Hastings, well up in the northern part of the state, has lately jumped into prominence in potato growing, the name of Hastings, Florida, being now almost as well known in that connection the world over as Aroostook, Maine. Hastings has never had a boom; it was built by no "colony" scheme. It has just grown, along with its potatoes, till now one may see there great farms, as level as a floor, where all the farm work is done by machinery in true Western style. Hastings has this year 4,000 acres in Irish potatoes. Last year it had 3,000 and shipped from its single railroad station 176,000 barrels at prices averaging, little and big, $3.50 per barrel F. O. B. Hastings. Shipments from the immediate neighborhood of Hastings swell the total to 204,000 barrels.

This is the way they do it. In late December they work into their soil by machine 1,800 pounds of fertilizer to the acre. Then they flood the soil with artesian water and let it soak for a week or two. In early January they begin planting potatoes, the variety decided upon as best for this region being Spaulding's Rose, Four, yielding 3½ to 4 barrels to the acre, put in by machine. Then they irrigate this land again. Cultivation to keep the land clean follows and the crop is harvested in April, usually by the 15th. A fair average of returns is 40 barrels to the acre though as high as 126 have been dug. But this is the first only of the season's crop from the land. After

FLORIDA LAND UNDER CULTIVATION.
A field of beans on Christmas Day near Fort Pierce, St. Lucie County.

April all possibility of frost is over and a crop of corn may be put in, no further fertilizer being needed. The corn is harvested in October at the rate of 40 barrels "slip-shuck" to the acre, netting 60 bushels, shelled. Then cow-peas are sown broadcast. With these grows, without seeding, the native crab-grass, the whole making an excellent hay which is harvested just before breaking the land for the next season's crop of potatoes. The hay averages 2½ tons, though 5 have been cut, to the acre, and brings $12.50 per ton, baled, F. O. B. Hastings. Such is the three crop round in the neighborhood of Hastings, though after potatoes various other crops may take the place of the corn and hay, according to the taste of the farmer. I cite these three because they are most common and are in no wise speculative crops. There is no danger of the potato business being overdone in Florida. New York City alone consumes 5,000 barrels of potatoes daily, and the Hastings potatoes reach the market just after those from Bermuda, thus bringing early crop prices. As a result of the Hastings success land in that region is being rapidly cleared and brought under cultivation. It sells at a mile from the station at $200 per acre, raw land being worth from $65 to $100.

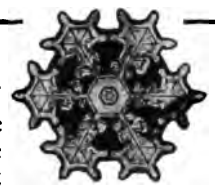
But—conditions in the region about Hastings are peculiar and in this peculiarity lies the success or failure of the greater part of Florida farming. Here about Hastings is a vast section, level as a floor, with a clay subsoil underlying it within a foot or two of the surface. Hence it holds water and fertilizer when these are put upon it. The land is thoroughly ditched and drained so that the torrential floods which occur at certain seasons in all parts of the state will quickly run off, saving the crops from the drowning which would otherwise be their lot. Artesian water in great quantity and of a quality that is not detrimental to crops is had by boring to a depth of about 225 feet. This is so piped that it may be turned on the crops in profusion when wanted. Otherwise at certain seasons the drought and fierce heat to which all portions of the state are liable would burn up the crops. These three conditions will doubtless be found in other parts of the state and in many sections. The whole country is so flat that this drainage is absolutely necessary. So is the water for irrigation. To try to farm without the two is to invite failure.

And yet—certain crops are being raised successfully without these conditions. One of these is pineapples. The pineapple is a sort of air-plant, anyway. It is propagated from slips, or suckers, which are set out in August in bare sand and fierce heat without watering. Strange to say these are never known to fail and the whole crop is grown without water, producing the juicy fruit in eighteen months from the setting of the cuttings. After that the crop comes yearly in summer without further planting, the plants covering the ground and needing no other care than fertilizing and harvesting of the fruit. Many men, however, have made a comparative failure of the business. Only certain portions of the state are favorable to the crop and even in these winter frosts sometimes do much damage.

Many of the "colonies" being planted out in the state are doomed to failure and disaster because of the unscrupulousness of their promoters. Florida land is "spotted." Rich alluvial soil in places lies beside barren sand that "will not grow cactus." Many big swamps seem incapable of drainage. Yet many promoters have no care for this. They advertise profusely and build on the true stories of fertility their own tissues of lies. They sell land to people at a distance who can afford to make but one trip and who do not see their land until they come with families and household goods to occupy it. Very many such are doomed to bitter disappointment. They are being herded into sections where neither a Florida Cracker nor a Seminole Indian could find a living. Of course, a man who buys land for settlement which he has never seen is a fool, but that does not alter the misery of it. Unless a purchaser knows that his land can be easily and thoroughly drained, unless he knows that—in most instances —water for irrigation is available, then however indomitable a farmer he may be he is inevitably doomed to failure sooner or later.

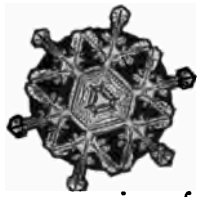
MARVEL of the SNOW GEMS

By Wilson A. Bentley



WHAT magic is in the rule that compels the snowflake to conform so rigidly to its laws? Here is a gem-bestrewn realm of nature possessing the charm of mystery, of the unknown, sure richly to reward the investigator.

For something over a quarter of a century I have been studying it and the work has proved to be wonderfully fascinating, for each favorable snow-fall, during all these years, has brought things that were new and beautiful to my hand. I have never yet found a time when I could entertain an idea of relinquishing it. During the time that I have carried on the work, I have secured sixteen hundred photo-micrographs of snow crystals alone, and no two are alike. Is there room for enthusiasm here? Doubtless these pictures serve to represent with some fairness almost every type and variety of snow that occurs in nature but they show scarcely an infinitesimal fraction of the individual variation of form and interior design among the countless myriads of crystals comprising each type.



The clouds, and the tiny liquid particles—water dust—of which they consist, play no part in true snow crystal formation. They coalesce only to form the amorphous—granular—varieties of the snow, or to coat true, mature crystals with granular material. The true crystals, forming the bulk of the snow fall, are formed directly from the almost infinitely small and invisible molecules of water in solution within the air, and floating between the vastly larger cloud particles.

Most of the crystals are, of course, imperfect, so especially thick and snowfalls, lar a result of cro and bunching development, fracturing violent winds. In general, the westen quadrants of widespread storm furnish the majority of the mor perfect tabular shapes. As rule, low clouds, if relativel warm, tend to produce the more rapidly growing open branching forms, and the intermediate and upper clouds, if relatively much colder, the more solid, close columnar and tabular forms. Sometimes, however, crystals differing but slight or not at all from tho falling from ston clouds, drop out of a parently cloud-free sk

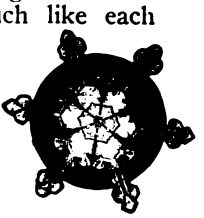
Much wonder been excited, because t snow crystals exhi such a bewildering diversity and beaut They form within a very thin gase solvent, the air, and this allows molecules of water an unexampled freedom of motion and adjustment while arranging themselves in crystal form. The fact doubtless largely explains why the crystals of snow far exceed other crystals in complexity and symmetry. Snow crystals, like crystals of water, develop under t hexagonal system and invariably divi into six. Nothing absolutely certain known, as to why they grow thus, exce as it is assumed that the number and a

rangement of the attractive and repellent poles possessed by the molecules of water, impose this habit of growth upon them. This dividing into six is necessarily discussed and best explained in somewhat technical sounding terms. We may assume each water particle or molecule possesses two opposite primary poles, positive and negative, corresponding in direction with the main tabular axis of the crystals, and in addition three or six equi-distant secondary poles, arranged around what may be called the equatorial diameters of the molecules. Water, being a dia-magnetic substance, and susceptible to polar repulsion, presumably has a tendency to arrange itself thus, in a position between and at right angles to the primary electro-magnetic poles. This alignment of the lines of growth, opposite to the lines of greater magnetic force, would compel the crystals of snow to grow mainly outward in the directions of their equatorial diameters and secondary poles. This theory would perhaps best explain why the crystals grow upon thin tabular or in the hollow columnar form, and increase so little in the direction of their main axes, that is, in the direction in which, it is assumed, their main positive and negative poles lie.

Each of the six parts or segments of the crystals, while in process of growth, increases simultaneously outward, yet each one usually grows independently and by itself. So each of the six parts may, for all practical purposes, be considered as being a separate crystal by itself, and the whole as being an aggregate of growing crystals. And the law under which they form not only gives them a general hexagonal plan of growth, but in addition gives them two specific secondary habits of growth, under the same plan.

We may best distinguish these as the outward or ray habit, and the concentric or layer habits of growth respectively. The ray habit causes growth to occur always outward and away from the nucleus. This tends to produce open branching forms. Crystals that grow rapidly, or within relatively warm low clouds, usually build upon this plan. In the case of the concentric or layer habit, growth tends to arrange itself in massive form, around the nucleus. This tends to produce the close, solid flakes. Slowly growing crystals, as the columnar, form solid tabular hexagons, and all such as crystallize in a very cold atmosphere, or at great altitudes, usually grow according to this latter habit. Snow producing clouds, if single are perhaps as a rule of some depth, or if double, or multiple, vary one with another in temperature. The growth habits and conditions under which the crystals form therefore are commonly unstable, with a multiplicity of diverse conditions, tending to hasten or to retard their rates of development, and momentarily, at least, to change or modify their forms. This state of things may cause them to grow after solid plans at one moment and altitude, after branching plans at another, after composite plans at yet others, and tends to cause them to become increasingly complex in outline and structure as growth progresses.

In those especially where the crystals form and grow within a singularly thin and uniform cloud, as within low detached clouds, for instance, they are likely to follow from start to finish after one single, uniform plan, and all be very much like each other. The frail branching snow crystals, falling during snow flurries, are oftentimes of this character. In some cases, the crystals will form composite fash-



ion, after but two specific plans. A solid, mosaic centerpiece portion will form within a cold upper air stratum and, falling earthward, acquire branching additions at some lower, warmer level. Composite crystals of this character perhaps exceed all others in beauty of design, combining into one, as they do, the two most beautiful types of snow.

It is all most marvelous and mysterious, these changing habits of growth, and this momentary shifting about of the points of maximum development. Growth ofttimes occurs in alternate order, first at the corners of the hexagon, and then at the sides. In some cases, this pendulum-like swing of outgrowth may continue from beginning to end.

But perhaps the most wonderful fact of all is the marvelously symmetrical way in which all this is accomplished. If a set of spangles or branches, or tiny hexagons or other adornments, form and grow at certain points upon any one of the six, or alternate, rays, or segments, similar or identical ones are almost sure to form at the same places and moments on all of the others, so that the balance of form is always kept unimpaired.

It appears as if the magic that does this might be, in part at least, of an electric nature, and due to the presence of tiny electric charges around their peripheries. Would not the presence at certain points, and the absence at others, of tiny electric charges, shifting momentarily about, as fresh charges collected, and causing momentary realignments in the locations of the several charges, stimulate growth at certain points and retard it at others? It seems worth while tentatively to advance this theory, as a possible explanation of these perplexing mysteries. But it is a fascinating mystery this, that the crystals assume such a marvelous diversity of form, though forced by the crystallographic law under which they come into being to assume always the hexagonal form. Six rays or parts, there always are, yet what an amazing variety these parts exhibit among themselves. Individual crystals of the open, branching variety, differ one from another, in the shape, size or thickness of their primary rays, and these rays in turn, in the number, size or shape, of the secondary branches that they possess. Those of solid tabular form differ as to their layers, or segments, and in the number and arrangement of the air tubes and shadings within them. Similarly those of a quasi-open formation vary in individual cases, in their spangles, the tiny hexagons composing them, as well as in the way in which these are combined with each other, or with rays, and arranged around the central nucleus. Yet in innumerable cases the crystals assume, at some one or more stages of growth, identical forms and outlines. It often happens that their nucleii, or ultimate outlines are alike, yet it seems to be rarely the case that any two pass through a long series of such changes of form. Hence the astonishing variety.

Snow crystals are noted among crystals because they bridge over and include within themselves so much of the solvent, air, wherein they form. This remarkable habit, in connection with the multitudinous changes of form gives great richness and complexity to their interior designs, and lends endless interest to their study. The air tubes and shadings have a biographical value, for they outline more or less perfectly, transitionary forms. The air tubes are largely formed while the crystals, or parts of such, are in process of solidification, as at the moment when branch unites to branch, layer to layer, or segment to segment, and so growth may be traced through its successive stages.

The snow crystals being, in the truest sense, exquisite works of art in themselves, charmingly adapt themselves to a great variety of uses in the industrial arts, and in various other ways. These uses are steadily broadening though they and their artistic possibilities have been as yet hardly discovered or realized by artisans in general. Metal workers, and wall paper manufacturers are, however, beginning to realize their value, and there should be a great field of usefulness for them in these lines. They also seem well adapted for use in designing patterns for porcelain, china, glassware and many other things. Silk manufacturers are beginning to see their adaptability as patterns. Their value as models in the realm of pure art is also being demonstrated. Their uses as models in

schools of art, and art craft shops are steadily increasing. Only recently Dr. Denman W. Ross, lecturer at Harvard on the theory of pure design, has adopted a large number for class room use. Prof. James Ward Stimson used them to illustrate the "beauty of nature's art," in his book, "The Gate Beautiful."

Perhaps their greatest field of usefulness, however, is along other lines, as objects for nature study, and for illustrating the forms of water. They should be invaluable to the crystallographer, for they show the forms and habits of growth of crystals in a most charming way.

Certain it is that normal and high schools, universities and museums both here and abroad, are finding them most useful in an educational way. One university alone—Wisconsin—has over one thousand lantern slides of snow-flakes.

Indeed it seems likely that these wonderful bits of pure beauty from the skies will soon come into their own, and receive the full appreciation and study to which their exquisite loveliness and great scientific interest entitle them.

BURGLAR-PROOF GLASS

By EDWARD BARTLETT

IF the French glassmakers continue their present experiments to the logical conclusion we shall perhaps one day be able to live in glass houses and throw as many stones as we like. Science is merciless, and it pauses no more at shattering old proverbs than it does of depriving boyhood of one of its chief destructive pleasures—that joyous conjunction of brickbat and window pane that has relieved the feelings of many a young savage pent up in town. The experiments have not yet progressed so far as that, but something has been accomplished in the way of making life harder for that close-pressed practitioner, the burglar.

The idea originated in Marseilles, which has troubles of its own in the way of criminal depredations. One day, a little more than a year ago, there was an apparently organized outbreak of *cambrio-leurs* in some of the principal streets of that city. In broad daylight, and in crowded thoroughfares, the windows of more than a dozen jewelry shops were smashed and objects of great value were successfully made way with. Some of the thieves were captured, and some made their escape, but the lesson remained, to the terror of jewelers and all others who made a practice of displaying valuable goods in their show-windows.

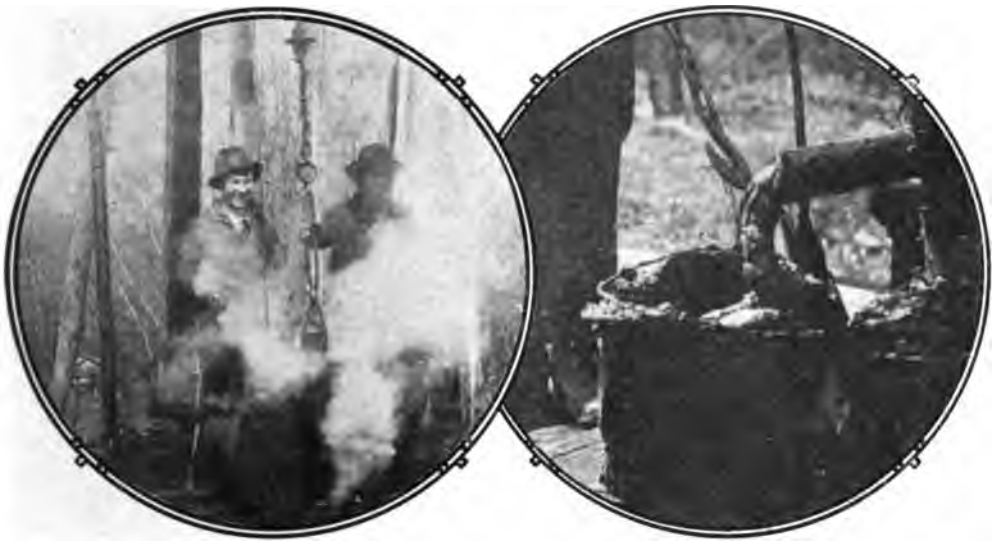
France is a country of iron shutters. The streets of a French city after eight or nine o'clock in the evening have the appearance of a place besieged, or at least infested with robbers and marauding bands. Every shop presents a curious aspect to American eyes, with its shutter let down to cover windows and doors with a sheet of iron that sledges and crowbars could scarcely penetrate. These precautions, which are taken in similar fashion in all private houses of every kind, even to the sixth floor windows of apartment houses and the great walled-in residences, are partly a survival of the Middle Ages and partly a necessary resistance to the attacks of criminals, who are nowhere so bold and persistent as in France. But it was a new thing, and terrifying, not to be able to display valuables in show-windows even in broad day.

M. Maurice Nugue, a mirror-maker

of Marseilles, got the notion that glass might be made sufficiently hard and thick to withstand any ordinary attack by burglars. The idea was quickly taken up by the Compagnie de Saint-Gobain, and experiments were made in the composition of tough slabs of glass of a thickness varying from 15 to 25 millimeters and of a clear transparency. Then tests were made of the resistance of the glass under such conditions as those of the episode in Marseilles. First a pane of ordinary plate glass was struck with an iron-capped mallet, hurled from a distance of three yards. A great hole was made in the glass, suffcient, had the pane been in a show-window, to have enabled a thief to plunder the window. The experiment was then repeated with a slab of the "burglar-proof" glass. This *dalle polie* was 20 millimeters in thickness. It was set in a window of ordinary shop size, but was framed in iron instead of the ordinary window sash of wood. The iron capped mallet made no impression on the glass when thrown at it from a distance of first three and then six yards. After that a disk of iron weighing ten pounds was hurled at the window, and this, at the lesser distance, had no other effect than a very slight bruise or abrasion on the surface of the *dalle polie*, but when the distance was increased a round hole was made in the glass. But this hole was only two centimeters in diameter on the surface of the glass. It did not extend clear through the pane, and there were no radiating fractures such as usually are seen when window-glass is broken. The final test was made with an army revolver, but the glass stopped the bullets when they had penetrated to the depth of one-quarter of a centimeter.

The experiments were regarded as successful, and a number of jewelers and others have placed this glass in their show windows. As the method of manufacturing this *dalle polie* is considered sufficiently important to be kept secret, the manager of the Compagnie Saint-Gobain was compelled to deny further information on the subject. He said, however, that after all thickness is the essential thing and that any tough glass if made sufficiently thick will answer the purpose and afford protection from ordinary attacks. But to make a glass of extreme thickness without the sacrifice of perfect transparency is a somewhat expensive process, and to meet the objections of cost and unwieldiness in "burglar-proof" glass the Compagnie Saint-Gobain has been conducting experiments along other lines. The employment of a light wire mesh or net is already well-known in America as well as in Europe. But the imbedding of this wire in the glass, while it gives it great strength, deprives it of perfect transparency, and the aim of the Compagnie Saint-Gobain has been to make something of this kind available for window glass as well as for places where only the admission of light is required.

The latest result of these experiments is a window-glass varying in thickness, according as the need may be, from a quarter of an inch to half an inch, and having imbedded in it a very light wire running in parallel, transverse lines about one inch apart. These lines of wire constitute, in effect, one continuous line starting from an upper corner of the pane, and running from left to right and right to left across the window without a break. The wire is connected with a battery and carries always a light charge of electricity. It is connected at one of the lower corners with a magnet. If the window is broken, and the wire with the glass, the electric current is broken, the magnet is released and by that action an alarm bell is set ringing. This bell may be placed anywhere within the house to rouse the occupants, or high up on the outer wall to summon the police or frighten the burglar away. As it would be impossible for a burglar to put even a hand through the glass without breaking the wire, and as the glass with its wire enforcement is very difficult to break, this product is regarded as more practical even than the very thick *dalle polie*. And the glass is almost perfectly transparent, the lines of wire being placed sufficiently far apart to interfere very little with the observation of the objects in a jeweler's show-window, thus in no way shutting off the display.



LOWERING CHARGED STEAMER INTO WELL TO DISSOLVE THE IMPEDING PARAFFIN.

PARAFFIN, AFTER STEAMING, BEING PUMPED FROM AN ABANDONED WELL.

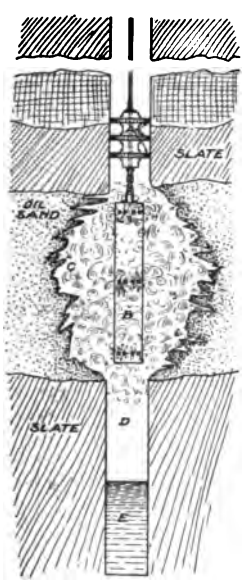
MAKING OLD OIL WELLS SPOUT

By RENÉ HOMER

WHY do oil wells, which have sprung so suddenly into life, cease almost as suddenly to pour gold into the coffers of the exploiters? Many a well's flow has been reduced to such an extent that it could no longer be pumped profitably, not on account of there being no longer oil at the base, but for the reason that the pores of the oil sands had become closed and would no longer permit of the passage of the fluid.

The great majority of oil wells are afflicted with paraffin wax, which sticks to the rock and closes the crevices and interstices and prevents the passage of the oil. This has long been the bane of the producers.

The first man yet to devise a successful means of overcoming this is a resident of Jamestown, N. Y., Dr. F. A. Monroe, and the invention has brought him prominently before the oil producing world. Dr. Monroe's invention, the efficacy of which has been positively demonstrated by its use in this section of the Appalachian field, means that the flowage of the wells now in operation may be materially increased, and that those in which pumping has been suspended may be rejuvenated.



HOW OIL WELLS ARE REOPENED.

a, Washer to prevent escape of steam; *b*, steamer; *c*, shot cavity; *d*, pocket; *e*, boiling water to catch paraffin.

The almost universal method up to this time of ridding wells of the paraffin evil has been the blasting process, which is, to say the least, crude. The use of nitro-glycerin for this purpose has always been found

STEAMER READY FOR LOWERING INTO WELL.

WITHDRAWING THE STEAMER FROM WELL.

quite expensive and not at all satisfactory.

That hot steam would melt the paraffin wax from the surface of the oil rock and permit the oil to run freely has been a well-known fact, but the difficulty heretofore has been in the degree of condensation which occurred by the time the steam reached the shot cavity. The boiling water which resulted, in addition to being injurious to the oil-bearing sands, caused the wax to set even harder than it had been before.

Dr. Monroe's device consists, first, of a metal tube twelve feet long and four and a quarter inches in diameter. In the upper part of this tube is inserted a cylinder containing water, with a small aperture at the bottom regulating the flow and distributing it evenly over the outside of a disk. In the lower part of the cylinder are inserted cast-iron billets which have been heated white hot; the ends of the tubing are then plugged. At three points in the tubing, near the top, bottom and center are rows of small holes. The water from the cylinder dropped on to these heated billets generates steam which is forced upward and out of these holes with great force, spraying the paraffin coated walls of the shot cavity with hot, dry steam.

LETTING WATER INTO THE STEAMER BEFORE BEGINNING OPERATIONS.

The tubing and rods are then drawn from the well and it is bailed dry. Boiling water is poured into the pocket below the shot-cavity until it is about half full. This water is poured in from the top and does not come in contact with the oil-bearing sand.

The steamer, already charged, is

lowered into the well and allowed to remain, steaming the upper portion of the shot-cavity. Inasmuch as the steamer will continue to generate hot superheated steam for from thirty-five to forty-five minutes, the whole cavity is filled with steam and the paraffin wax well started to running before the steamer is cool.

Before withdrawing, the steamer is lowered so that the lower half, containing the heated billets, rests in the water which was put into the shot-cavity, bringing that to a boiling point. The steamer is then withdrawn and another already charged and waiting is immediately lowered into the well.

This operation is continued for from five to eight hours, until all the paraffin that has adhered to the walls of the shot-cavity has been melted and run down, and is held in suspension by the hot water in the pocket below the shot-cavity. The hot water and melted paraffin are then bailed out before allowing them to cool, removing absolutely every bit of paraffin that adhered to the well. The tubing and rods are cleaned and replaced, and any repairs to the pump or apparatus are made, leaving the well in perfect condition and making certain that the maximum flow of oil will be secured.

The Western well drillers also have their troubles, due, however, to a different cause. The average California oil is heavy and contains much asphalt. In the Utah, Wyoming, Colorado and other less important oil fields both paraffin and asphalt exist. Dr. Monroe shows that he can successfully cope with the asphalt evil also.

MACHINE FOR LOWERING AND RAISING THE STEAMER.
In the foreground are the ovens for heating the billets white hot.

The melting point of crude asphalt such as is held in solution by crude petroleum runs between 110 and 170 degrees Fahrenheit. At this temperature it has the same viscosity as oil and will melt and run freely. The steamer keeps the water in the pocket at a temperature of 120 to 180 degrees; that is, this temperature is found to exist in the bailings after the well has been steamed, and the actual temperature at the bottom is, therefore, necessarily much higher.

In the majority of the oil fields there

GETTING READY FOR THE TREATMENT.

has been within the past few years a very noticeable decline in the yearly output of crude petroleum. The figures here given are taken from the report of the Department of the Interior, United States Geological Survey for the calendar year of 1907. The report for that year was made under the direction of Mr. George Otis Smith, one of the most reliable and careful statisticians in the employ of the Federal government.

According to the report, the decrease in the Appalachian field for that year amounted to 8.65 per cent. Although small, this decrease is rendered most significant by the fact that strenuous efforts were made during that year to develop new territory. Hundreds of new wells were sunk, entailing an enormous outlay of money, but the number which proved producers was not sufficiently large to offset the decrease in the flowage of the old wells, undoubtedly caused by the paraffin wax evil.

INSERTING THE WHITE-HOT BILLETS INTO STEAMER.

Dr. Monroe's invention is one of those apparently simple things that men have long striven to accomplish, yet which have proved baffling because of some hitch, apparently slight, caused by inability to overcome some obstacle or perfect some lesser detail. This invention means long life to oil wells.

TO SLAKE A CITY'S THIRST

By C. F. CARTER

ANYONE who would like to see how near modern machinery manipulated by a perfect organization can come to working miracles would do well to journey up to Brown's Station any time after the grass starts in the spring. There will be found from eighteen hundred to twenty-five hundred skilled workers who, having smashed all the world's records connected with earth-work, quarrying and concrete construction, now have no higher aim than to excel their own notable achievements. The workers are idle now, for in the presence of the Frost King organization is impotent and machinery is of no avail.

Brown's Station? Oh, yes! Why, Brown's Station is one hundred and five miles from Weehawken which, not being on Manhattan Island, is of no consequence whatever and so need not be considered further.

The end for which the men, the organization and the machinery have been assembled is the building of a lake twelve miles long, two miles wide, having a shore line of forty miles, a maximum depth of one hundred and ninety feet and an average depth of fifty feet, for and in consideration of the sum of twelve million six hundred and sixty thousand dollars more or less, depending upon whether the actual amount of work done measures up to or exceeds the estimates. The job is said to be the biggest ever done on a single contract and is the second largest engineering undertaking now on hand in the world. The Panama Canal, which alone exceeds it in magnitude, is not being done by contract. If it was, the American people probably would find themselves a hundred million dollars or so richer when it was all over.

But speaking of the lake, it is to be divided, by a dike, which is an earth

SPECIAL TYPE OF LOCOMOTIVE USED IN WORK OF BUILDING THE ASHOKAN RESERVOIR.

THE BEGINNING OF THE WORK.
Excavating with steam shovel.

embankment with a concrete core, into two parts like two links of sausage hung on a peg, the peg in this instance being a "mountain"—any way it passes for a mountain in the Catskills—three or four hundred feet high which thrusts itself forward so as to bend the lake into an obtuse angle right in the middle. Together the two links will be known as "Ashokan Reservoir," which, with controlling works, an aqueduct seventeen feet square and ninety-two miles long, a storage reservoir and aerating plants and filter beds will constitute a new water system which the taxpayers know will cost them at least one hundred and sixty-two million dollars, and which they hope may provide Greater New York with an additional five hundred million gallons of water a day.

Now, it cannot be denied that to encourage New York to use more water is praiseworthy; but on the other hand the Ashokan Reservoir will submerge and render useless more than fifteen thousand acres of good land in the Catskills where the principal industry is keeping summer boarders and where standing room is at a premium in the dog days. A good many summer boarders could be pastured on fifteen thousand acres.

A ROAD ROLLER FOR PACKING DOWN THE EARTHWORK OF THE DIKES.

Most interesting of all the machinery at Brown's Station is Brown's Station itself, a neat and wholesome town of three thousand inhabitants. It is interesting, first, because it is so different; and, second, because it so efficiently serves the purpose for which it was built. To be sure, there is nothing remarkable about a town of three thousand inhabitants having schools for the children, and night schools,

debating societies and private theatricals for their elders. But Brown's Station, which has all these frills and more besides, is a contractor's camp and nothing else; and any old time contractor can tell you that in the average camp the day is divided into three periods: eight hours work, eight hours sleep and eight hours "merry hell." At Brown's Station the last named period is totally eliminated, yet the population is a weirdly incongruous mixture of Irish, Italians, Poles, Hungarians, Russians and Americans, both plain and colored.

Instead of nights made hideous with brawls and drunkenness the hours of darkness are never disturbed by anything more indecorous than the laughter and chatter of groups of Italians, Poles and Russians on their way home after an evening at the schoolhouses practising their newly acquired English in debating such burning issues as "Resolved, that war is less dangerous than women's suffrage."

This idyllic condition is brought about by several influences, one of the most important being the bank. By paying three per cent interest on savings deposits the bank, believed to be the first ever established in a contractor's camp, is teaching the men that money can be invested in something more conservative than whiskey. The statement of November 16, 1909, showed deposits of more than sixty-two thousand dollars. Not only is thrift encouraged but theft is discouraged by depositing all the spare change in camp in the bank. Moreover, as the men are paid in checks which are cashed at the bank, there is no wearisome lineup for hours at the paymaster's window every two weeks. The men drop in when they happen to think of them, to get their checks, which are turned over to the women folk to deposit when it is convenient. The direct result of this practical lesson on the value of money is seen in the appearance of every one in town. One must needs travel far and long to find a better fed, neater clad, more contented looking lot of workmen than those at Brown's Station.

Another shrewd move by Macarthur Brothers and Winston, the contractors, was to abolish the almanac. There are no Sundays and no holidays at Brown's Station. Work goes right along every day in two shifts of eight hours each until the ground freezes up, when the contractors know it is time to quit. When it thaws out in the spring they know it is time to go to work again. This arrangement keeps the men so busy they never can find time to get drunk.

Still the presence of the bank and the absence of the almanac do not wholly account for Brown's Station. No small part of its virtues is attributable to Chief of Police Bates. The sale of whiskey being absolutely forbidden in the town

THE WALLS BEGIN TO RISE.

or near it, enterprising bootleggers are constantly harboring the delusion that they can turn a neat trick by smuggling liquor into camp. "The Chief" is always the first to meet such visitors; and his parting kick is so enthusiastic, though always bestowed where it is least likely to break bones, that it is invariably construed as a hint that the bootlegger's room is preferred to his company.

Moreover, the Chief takes a fatherly interest in everybody in camp. His aim is always to pour soothing syrup on troubled tempers, but he had to lock up three of its biggest bullies before the camp could understand that he would have no foolishness about it. Since then the hinges on his cell doors have grown rusty from long disuse.

For a colored man to shoot craps seems to be as necessary as it is for him to breathe. The Chief, being a sensible man, makes no attempt to check the crap shooting; but if a game results in boisterous language, to say nothing of razors, or if it is prolonged beyond a highly respectable hour for retiring, the delinquents find themselves hustled into outer darkness by sinewy fingers twined in their collars. And as certain as the next morning comes they will be led out of camp and told to keep on going. Consequently craps as played at Brown's Station is about as thrilling as the game of "jacks" indulged in by very little girls.

Brown's Station, of course, has such fundamentals as a sewer system with a model treatment plant, water works that furnish 35,000 gallons a day for domestic consumption and a separate system that furnishes 500,000 gallons a day for feeding boilers, mixing concrete and other industrial uses, a fire department, a well equipped hospital, churches, cold storage plant, department store, and schools. In fact the Chief Engineer of the works, F. H. Trow, is also director and chief engineer of the school system.

HOW THE CONCRETE BLOCKS FOR THE DAM ARE MADE.

TEARING UP THE EARTH TO CONSTRUCT FOUNDATIONS AT THE OLIVE BRIDGE DAM.

When he came, work on the big dam was not allowed to interfere with the task of getting the schools to running smoothly.

But what has all this to do with the machinery with which this great undertaking is being carried out, you ask? Why, it has everything to do with it. No machine can do anything without men to run it; and no man ever yet got as much out of a machine as a better man could get. Brown's Station is as far removed as possible from an eleemosynary institution. It is a vital part of a most remarkable system, designed with the same care as a railroad or a concrete mixing plant, but with no more sentiment. Men simply could not do what is required of them at Brown's Station if they were not kept in fit condition; and if they did not keep up to the mark the contractors would earn a deficit instead of a profit. Few lines of human endeavor offer so many or so diverse opportunities for losing money as "contracting," which term, for some inexplicable reason is always understood to be limited to contracting for work in earthwork or stone. Things that to the uninitiated seem trifling often turn the scale from profit to loss.

So fine are lines drawn at Brown's Station that a negro tender at a cube concrete mixer who gave the cube a single extra turn to drain it more thoroughly of its contents received Hail Columbia from his boss, who mourned and would not be comforted for the three seconds that were lost by that superfluous turn. It was this eager interest in the seconds of time on the part of the boss and his gang that enabled them to paint in bold black letters, on the wall of their building, the remarkable record of four hundred and forty cubic yards of concrete mixed in eight hours in one cube mixer of two and one-half yards capacity, as a challenge to the whole world to equal—if it can.

It was the same lively interest in the seconds of men who were fit that led to

GALE QUARRY—WHERE THE ROCK FOR THE BIG DAM COMES FROM.

the breaking of the world's record in concrete masonry construction in the month of October. Not only was more masonry put in place than ever was laid in any other structure in the same length of time, but the mark was placed so far beyond all previous achievements that none but the same gang is ever likely to surpass it. The total for the month was 35,259 cubic yards, which added to the main dam a solid mass 800 feet long, 120 feet wide and ten feet high. The nearest approach to these figures was 26,000 cubic yards laid in a single month on the Croton Falls dam a year previously. In the irrigation work of the government reclamation service in the west the highest record for a month was 18,000 cubic yards on the Roosevelt dam.

Although New York might not know a cube concrete mixer if it met one on the street, and thinks of a dam only as an expletive wherewith to characterize an unpleasant turn in the stock market, it is nearly as much interested in all this record breaking as in the results of the races at New Orleans. For the present consumption, or rather waste, of water in New York, 348,500,000 gallons a day is not only quite up to the average supply and beyond the supply available in a dry season, but it is increasing at a rate that fills the breasts of the Board of Water Supply with all the alarm compatible with fat salaries. Hence, the Board, while allowing the contractors until 1915 to complete the job, stipulated that the work should be so far advanced that on August 12, 1912, the delivery of some water could be commenced. To make sure that this was done the Board figured out a little schedule of progress showing the kind and amount of work that would have to be done monthly to get through. But the way the all-star aggregation assembled by the contractors is tearing up the earth makes the Board's schedule look like a joke; for eighteen months after the beginning, the work completed was fifty per cent ahead of the amount required by the schedule.

In order to impound 127,000,000,000 gallons of water—which is enough to cover the whole of Manhattan Island twenty-eight feet deep—at an elevation of 490 feet above sea level it is necessary to build one dam, known as "The Olive Bridge Dam," with a central portion of masonry 1,000 feet long, 200 feet wide at the bottom and twenty-six feet wide at the top, 210 feet high and containing 550,000 cubic yards of masonry, flanked by earth embankments 3,600 feet long,

800 feet wide at the base and thirty-four feet wide at the top, containing 2,000,000 cubic yards of material. Other dikes, having a total length of three and eight-tenths miles, must be built, all dikes or earth embankments having a central core of concrete extending from bed-rock to the top of the dike and the embankment being faced on both sides with rubble stone. The total amount of material to be handled may be summarized as follows:

CONDUIT THROUGH WHICH ESOPUS CREEK NOW RUNS. WITH MAIN ROCK CRUSHING AND CONCRETE MIXING PLANT IN THE BACKGROUND.

Item.	Cubic Yards.
Earth excavation	2,055,000
Rock excavation	425,000
Embankment and refilling	7,200,000
Masonry	874,000
Rubble and rip-rap	105,000
	Barrels.
Portland Cement required	1,100,000

If the Ashokan Reservoir were to be built like the first portions of the Suez Canal was built fifty years ago, by men scooping up the sand with their bare hands into baskets which they carried up to the dump and emptied, it would be some time after 1912 before New York had an additional water supply. Even with shovels men could hardly finish the job by the time the water was needed. It takes 150 shovels full of earth to make a cubic yard. Some writers on engineering allege that a man can shovel 18.24 cubic yards of loose material in eight hours. Up at Brown's Station there is earth in which a good man can shovel no more than two yards in eight hours. But even at eighteen yards and a quarter a day, which would mean a shovelful for every eleven seconds of the eight hours, it would take one man 311 years to do the earth excavating on the Ashokan Reservoir and 1,095 years more to throw up the embankments, provided he worked every

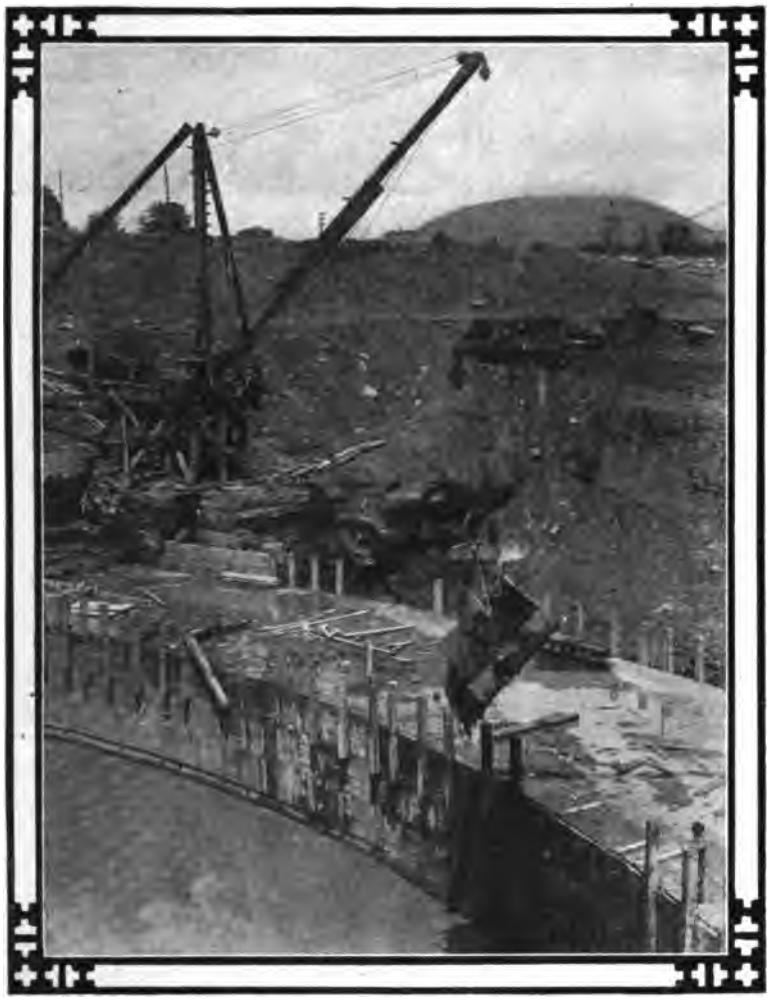
day at the same gait and could throw every shovelful into its final positon so that he would have to handle nothing twice, which, of course, would be wildly impossible.

But Macarthur Brothers and Winston have got so far beyond the Suez Canal method that the boss in charge felt called upon to volunteer an apology because I happened upon a gang of men loading a skip with broken stone by hand. There were compressed air channeling machines, drills and dynamite to cut the rock and break it up, but it was in a channel leading from a gate house site too narrow to get a steam shovel into.

That once, however, was the only time the rock was touched by human hands or by hand tools. After the steel skip was loaded with five cubic yards of broken stone it was snatched up by a traveler on a cableway, swung through the air at a speed of 1,200 feet a minute and dropped on a car on a standard gauge railroad. Three skips made a car load and seven cars made a train load. The instant the last skip was in place the train, drawn by a mogul locomotive, sped away to the main stone crushing plant beside the big dam. Here a derrick lifted the skips off the cars, dumped the stone into a hopper and set the skips back on the cars. From the hopper the stone was fed into a crusher automatically, the crushed stone was automatically screened and sorted into sizes and elevated into bins from which it was fed by gravity into the concrete mixers on the opening of a gate. From the mixer it was poured into a steel bucket holding three and a half cubic yards setting on a car on which it was hauled within reach of cableways spanning the dam. Here travelers picked up the bucket and passed it along to a derrick which dumped the mixture where it was needed and returned the bucket to the traveler. The routine on the dam is an imitation of the work of a bucket brigade at a fire, only this mechanical bucket brigade never gets rattled nor out of breath, nor does it ever make a false move. As this one plant alone uses twelve carloads of cement a day, double that quantity of sand and four times that amount of broken stone, it keeps the railroad and the cable ways and the derricks hustling. As for the men they never could pick up that amount of stone by hand even if it was available in excavations, which it isn't. So to help them out a quarry is operated three miles from the dam. There ten steam derricks and other machinery in proportion tear out a thousand cubic yards of stone a day and

A Worker's Shanty, Type of Italian dwelling.

Types of Houses at Brown's Station—the Ideal Contractor's Camp.



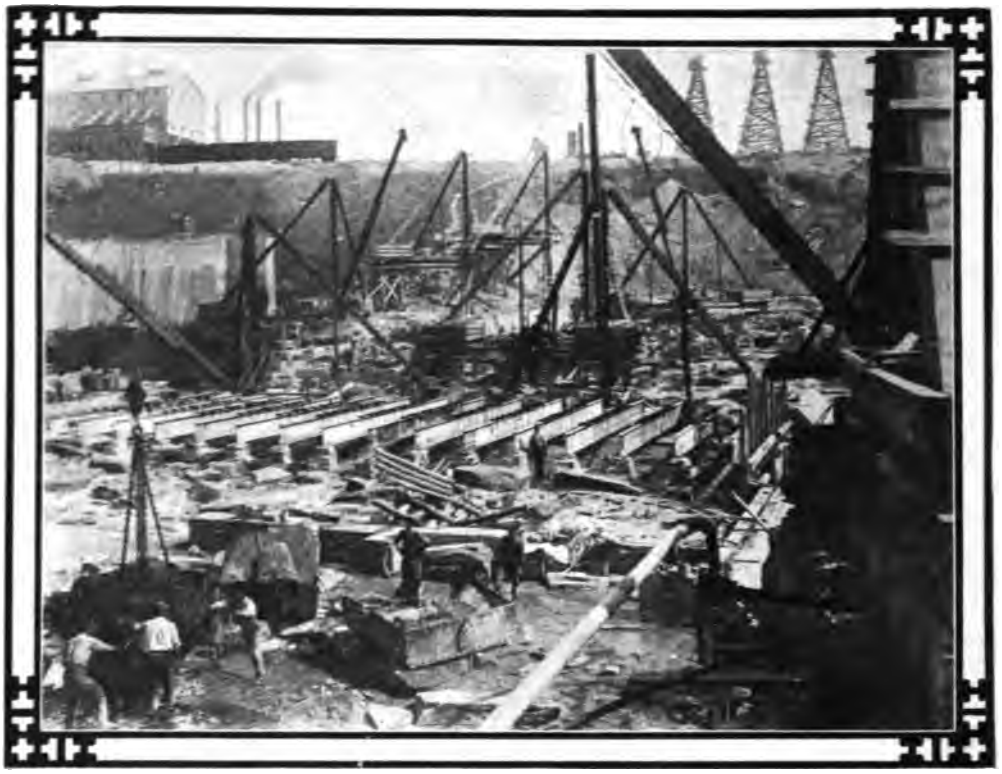
CORE WALL IN THE BEAVER KILL GORGE.

ship it over a double track standard gauge railroad to the mixer and the dam. The smaller stone is scooped up by a steam shovel and dumped into a crusher at the quarry or shipped in skips to the main crushing plant. The big pieces of rock, weighing a ton or more, are loaded by derricks on to trains and taken to the dam just as they are to form part of the cyclopean concrete filling.

Broken stone needed for concrete on a distant part of the works is returned by rail to a concrete mixer on the spot where it is handled in the same manner as at the main plant.

The face of the dam is built of molded concrete blocks seven feet long by two and one-half feet thick. As one face of the expansion joints in the dam is also built of blocks it takes a good many of them. These expansion joints, by the way, are a novelty on which great hopes of immunity from cracks and disaster are based. These are dovetailed joints, tooled true and well greased so that the concrete can slip easily, extending transversely across the dam at intervals of eighty feet. The dam, in fact, is actually built in sections eighty feet long. When the concrete gets ready to shrink it can go right ahead and shrink all it pleases without in the least impairing the strength of the dam.

The big concrete blocks are molded in



TOP OF THE OLIVE BRIDGE DAM SHOWING STEEL I-BEAMS FOR MASONRY SUPPORT OVER CONDUIT.

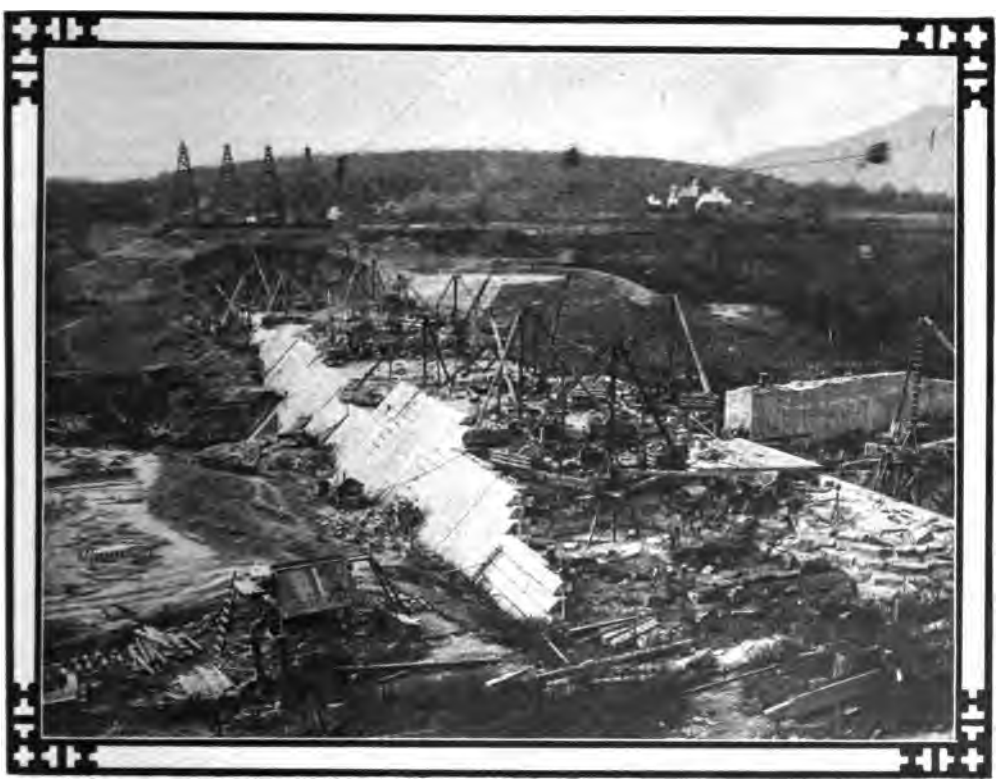
a yard 200 feet wide by 700 feet long. The molds, made of two inch plank planed and greased, and with a greased steel plate for the face of the block, are strongly framed and braced. They are lined up in ranks of six between and on either side of two parallel tracks. The buckets of concrete are hauled out on the tracks within reach of a derrick which dumps the buckets on a platform from which the concrete is shoveled into the molds. This platform rests on trucks running on the tracks so that it can travel up and down the yard as needed. It takes the molding gang several days to fill the three hundred and fifty molds. Forty-eight hours after filling the blocks are firm enough to allow the molds to be stripped off, and a few days later are hard enough to be lifted by a derrick and stacked up to cure for at least three months before they can go to their place in the dam. A constant stream of concrete is flowing out of the mixing plant in both directions, one part to the molding yard, the other to the dam.

In building the monster dikes every move is performed by machinery. In one place where there is plenty of material of the right sort within fifteen hundred feet of a dike, a steam shovel loads the dirt into dump wagons holding one and one-half cubic yards drawn by three mules. Those mules, by the way, are an interesting instance of the accuracy with which the punishment is made to fit the crime at Brown's Station. A mule may not be able to pull more than a horse of the same age and weight in a spurt; but in a given period of time a hundred mules can be depended upon to perform more work than a hundred horses. Hence mules do all the hauling that cannot be done by railroad or cableway, and it takes two hundred and eighty of them to do it. As the mule and the darky long since arrived at a mutually satisfactory understanding, the mule will

do more work for a darky than he can be persuaded to do for a white man. Therefore each three mule team has a colored driver.

The wagons move in an endless procession up to the shovel, are loaded with a single dipper full, proceed to the dike where the driver pulls a lever which dumps the load without stopping. A four wheeled slip scraper drawn by four mules levels the material into a layer six inches deep. Then a steam roller with all its wheels corrugated and cleated after special designs for this work jumps on to that material with a pressure of thirty pounds to the square inch and punches and pounds and rolls the stuff, like a woman kneading bread, until it is packed into a mass so dense that a cubic foot of it weighs 130 pounds and as solidly in place as the eternal hills. Any water that can percolate through five hundred feet of that stuff, not to mention the concrete core eight feet thick in the middle of it, will be regarded as having earned its freedom and so will not be sent to New York City. From the time the material leaves its original position until it is settled in its final resting place it is never touched by a hand tool. Material that has to be hauled longer distances is loaded by steam shovels into skips which are hauled by railroad under a cableway which picks up the skips and dumps them in place, the engineer doing the trick by pulling a valve on bell signals from a man who reclines luxuriously in a little bird cage on stilts overlooking the work.

These cableways with their sprawling towers scattered everywhere form the most conspicuous feature of a mechanical plant of impressive size. Machinery catalogues do not generally make very fascinating reading; but in this case perhaps a chapter from Macarthur Brothers and Winston's catalogue may aid materially in conveying an impression of the magnitude of the work at Brown's Station.



LOOKING TOWARD THE SOUTH WING OF THE OLIVE BRIDGE DAM.

The mechanical plant, then, includes fifteen miles of standard gauge railroad, with a double track main line on which is a steel viaduct 390 feet long and eighty-five feet high, and five miles of narrow gauge railroad. The rolling stock on the railroad system includes nine mogul locomotives and 265 cars. The main power plant has four air compressors aggregating sixteen hundred horse power. Air is piped as much as four miles from the station to run drills, channelers and the forty hoisting engines run by air. There are eleven other hoisting engines run by steam. There are eight steam shovels, four of them being seventy-ton machines, five steam rollers and two rock crushing plants with an aggregate capacity of 1,300 cubic yards of rock a day.

There is a carpenter shop equipped with planers, band and circular saws, lathes, etc., and a machine shop with lathes, planers, steam hammers and the like for making repairs and a bolt making machine, and a nine stall roundhouse.

The issuing storehouse thirty feet wide by 200 feet long carries a stock valued at $70,000 or more and it keeps three men constantly busy handing out supplies and parts to repair broken machinery. All the principal parts of the various makes of engines and machines are carried in stock so that delays from breakdowns may be as brief as possible. For other parts patterns are kept at a foundry in Kingston sixteen miles distant and the parts are ordered by wire from there instead of waiting for them to come from a factory a thousand miles or more away.

With such a formidable array of machinery it would seem as if nothing was left to be done by hand; yet, in the season of 1909, 1,800 shovels and 840 picks were worn out or broken by the Italians, who being artists with such implements, are exclusively employed in that line of work.

The Eternal Purpose

O, yet we trust that somehow good
Will be the final goal of ill,
To pangs of nature, sins of will,
Defects of doubt, and taints of blood;

That nothing walks with aimless feet;
That not one life shall be destroyed,
Or cast as rubbish to the void,
When God hath made the pile complete;

That not a worm is cloven in vain,
That not a moth with vain desire
Is shriveled in a fruitless fire,
Or but subserves another's gain.

—ALFRED TENNYSON.

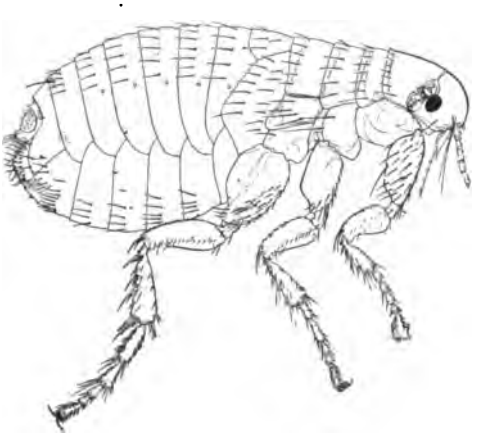
THE WICKED FLEA—A MENACE

By WILLIAM COLBY RUCKER

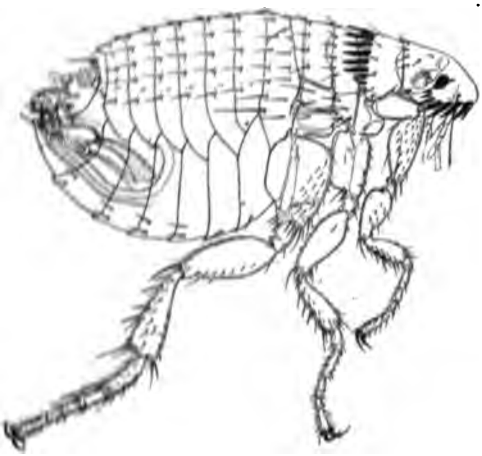
Passed Assistant Surgeon, United States Public Health and Marine-Hospital Service

IF some one were to tell you of a creature covered with a heavy armor of horn and provided with two large, triangular slashing weapons in addition to two lances and a very sharp stiletto, having the longest and most powerful hind legs of any being in existence, so strong and powerful that the animal could jump five hundred times its own length, and if you were to be further told that this creature was abroad upon the face of the earth today, causing more deaths annually than all the venomous reptiles and ferocious beasts in the world, would you not imagine that the narrator was the victim of hallucinations far outclassing those of the most habituated pipe-dreamer? Yet such a creature does exist and in many varying forms is found in almost every quarter of the globe and upon practically every animal having a hairy coat. It is only in recent years, however, that this insect, the flea—there, the secret is out—has excited anything more than a natural curiosity on the part of the scientists who desire to know and catalogue every living thing upon the surface of the earth. In fact, it was not until 1740 that von Liny, a Swedish naturalist, who made a practice of giving a Latin label to everything, finding one day a busy flea industriously staking out town lots on his anatomy, called it a pulex irritans. Aside from the sleepless nights and an exasperating desire to scratch in polite society caused by this agile creature, it failed to excite great interest until 1880 when Taschenberg made a careful study of all the then known fleas. He classified them and studied their anatomy, laying the foundation upon which practically all of the modern work rests. Later the Rothschilds in England, Tirahoschi in Italy and Baker in the United States published valuable, but to the non-scientific reader—uninteresting, accounts of this pusillanimous pest. All of these investigators considered the flea from the standpiont of pure science and it was not until Simpson, the English plague expert, suggested the possibility of the flea as an intermediary in the transmission of pest that scientists began to see a practical application of all the knowledge gained at the cost of so much arduous toil. The credit for the demonstration of the transference of plague by these insects goes

THE HUMAN FLEA—MALE.
Also found on the hog and skunk.



THE HUMAN FLEA—FEMALE.

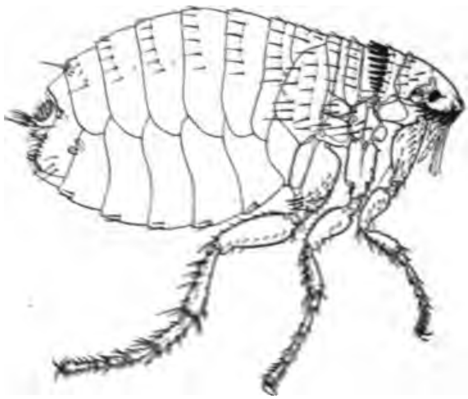


THE COMMON DOG AND CAT FLEA—MALE.

by priority to Verbitsky, a Russian student who presented an elaborate thesis on the subject when he came up for his medical degree. Unfortunately his work was written in Russian, practically a sealed book to the reading world outside the domain of the "Little Father," and it was not until several years later that it was translated into English and published. In the meantime, Liston, an Englishman, had been doing some pioneer work in the life history of fleas, especially with regard to their breeding, and their role as carriers of the disease. Then the British Commission in India took up the task and after an elaborate set of brilliantly conceived experiments proved beyond cavil the malevolent part played by the flea as a vehicle in the distribution of the "black death." Corroborative work was done in Australia by [illegible] and lastly we have the findings of the United States Public Health and Marine Hospital Service during the San Francisco campaign against bubonic plague.

Fleas are a branch of the fly family which has degenerated and fallen into [illegible]. In fact, no self-respecting fly would be seen in the company of a flea. [illegible] contact at all as flea eggs are most often deposited in dust found in floor cracks or the debris of the nest of the host, while fly eggs are laid in meat or manure.

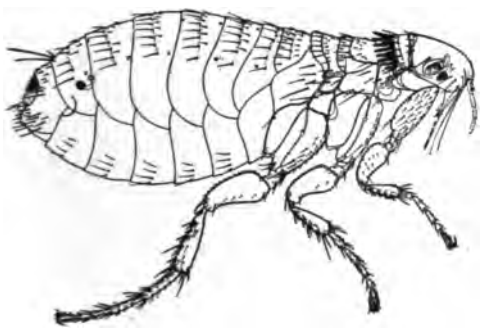
Almost every animal having a coat of hair has his own particular variety of flea. In other words, fleas vary with their host, but one host may harbor six different species of fleas or one species may occupy six different hosts. In general it may be said, however, that each flea-bearing animal has its own choice stock within its flea preserves. For example, man elects the pulex irritans (parenthetically it may be noted that this species is also chosen by the skunk and the hog); the dog, the ctenocephalus canis, while the mouse has a little blind flea of its own.



THE COMMON DOG AND CAT FLEA—FEMALE.

The recognition of these various species is not necessarily a matter of scientific study, each flea presenting a very different appearance even to the most casual observer providing he has a magnifying glass of moderate power. The ceratophyllus fasciatus, the common rat flea of the United States, has a collar of heavy spikes about its neck giving it the appearance of a Fifth Avenue bull dog; the ctenopsyllus musculi, the mouse flea, is blind; the ctenocephalus canis has a large cavalryman moustache of heavy spines; the pulex irritans is globular in shape and has no collar at all, while the rabbit's flea, the hoplopsyllus affinus, has two heavy clasping plates resembling a pair of ice tongs with which he anchors himself to his victim.

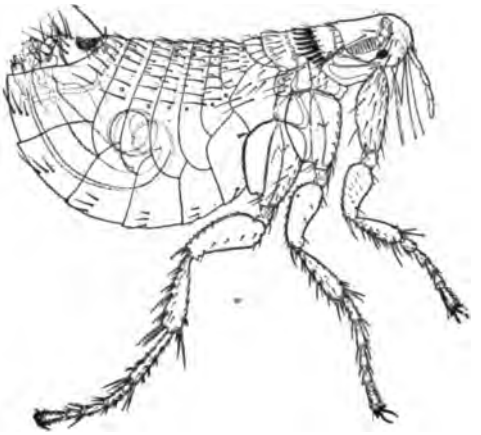
Flea eggs are minute, waxy, spherical bodies and are usually laid in the dust of the floor crack or other convenient place chosen by the mother. They vary from five to twenty in number according to species, and a good layer will deposit about one hundred and twenty in the course of her life. The egg stage lasts from two to eight days, during which time there is a constant development going on inside the little waxy globules. A small maggot is being formed inside the egg, in which it lies in a coil with head and tail touching. Nature provides this little white worm with a very effective instrument with which to gain access to the outside world. This consists of a strong wedge-shaped spike turned into a hook at the end and having as its base



THE COMMON RAT FLEA OF AMERICA—FEMALE.

the part corresponding to the back of the neck. When the time of emersion arrives the maggot bends the head downwards, thus throwing the spike into play, and by straightening its body with the head still bent catches the hook in the fragile shell in which it is encased, rends it asunder and wiggles out into the light of day.

The immediate concern of our little specimen is food, and fortunately this has usually been prepared for him by his thoughtful mother who has deposited a little pellicle of blood on the egg shell or in the immediate vicinity, thus providing for this very occasion. In case, however, the mother flea is a society lady, leaving the care of her offspring to chance, the young infant moves about actively looking for food. Small scales of skin, crumbs or organic dust of any sort are eaten with avidity. In case these are not



COMMON RAT FLEA OF AMERICA—MALE.

found, however, the maggot may live as long as eight days upon the food-cache left behind by its foresighted parent. This fact led previous observers to believe that the blood pellicle was the sole diet of the infant flea, but recent observations made by Mr. Maurice B. Mitzmain, the Government entomologist of the San Francisco plague fighters, from whom much of the data contained in this article has been secured, has proved this theory to be incorrect. This scientist has studied the life history of the flea from the cradle to the grave in all its minutiae. He has captured living specimens of most of the California species, collected the eggs and observed the various developmental stages, many times working far into the night in order that he might miss no detail of the process. The results of his labor are not only important in that they add to the scientific knowledge of the world, but they also have an intensely practical bearing in the fact that in this way only can we discover the means of ridding ourselves of a dangerous foe to mankind.

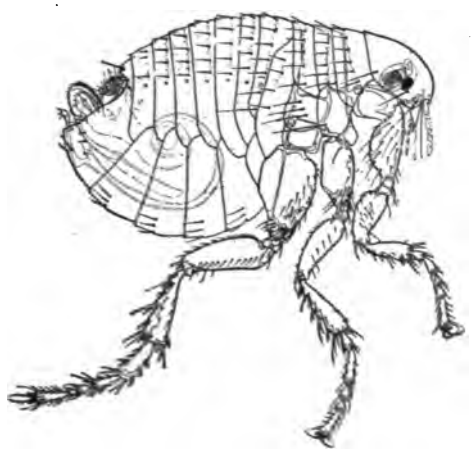
Having satisfied the clamoring of the inner maggot, the flea in embryo turns its attention to the matter of dress, changing his coat three times and showing an increasing fondness for the darker colors, until at last he dons fawn colored apparel. The exact hue of this raiment depends very largely upon the character of the food taken. During the twelve to thirty days occupied by this stage the little worm becomes more and more

sluggish. This is caused by the fact that he gormandizes himself to provide for the long fast which is to come in the cocoon stage.

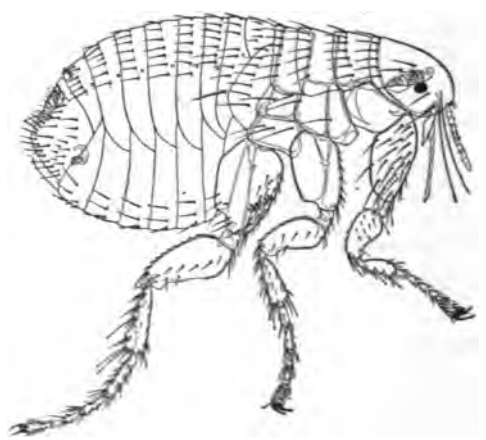
Being clothed and having eaten, the maggot seeks a convenient spot in which to build a little home. Collecting sand, wood, paper, straw or hair into a little heap as a base, he lays upon it as a foundation a little silken net work and getting on this proceeds to spin about himself a beautiful silky cocoon. In about two days this silken bower is complete and here he rests, fasts and meditates from twelve to thirty days while the long, powerful hind legs, mouth parts, armor and weapons emerge from the little sacks in which they are encased.

This process completed, it bores and tears its way by means of its sharp spines through one end of the cocoon and emerges a well developed but youthful flea. He now becomes an explorer and having oriented himself, seeks with assiduity a warm blooded host. The pangs of hunger are calling for easement, but the youthful flea can travel two weeks without food. In this connection it is interesting to note that if it is fed at once and then starved for five days it will die, but if not fed at all, two weeks will elapse before death. Adult life has now begun. The length of this is entirely problematical, but fleas have been kept alive under artificial conditions for six months in the San Francisco laboratory of the United States Public Health and Marine-Hospital Service. An interesting series of experiments to determine this fact were undertaken by Passed Assistant Surgeon George W. McCoy, the chief of the laboratory, and Mr. M. B. Mitzmain. The fleas were kept in test tubes having proper ventilation and each day these self-sacrificing investigators would sit by the hour holding the fleas under inverted tubes upon their bare arms allowing the insects to greedily secure a meal. Notes were taken as to just how long each one fed and exactly the process by which the food was extracted. The results proved of such scientific value that the Federal health service issued them as a public document.

The flea, whose life history from infancy to old age we are following, has an oval body which is flattened to permit easy progress through the hair of its host. It is as though this insect had been laterally narrowed so that it might move with ease in the hairy forest which it inhabits. It is covered, armadilla-like, with heavy plates of chitin laid on like the shingles of a house. This chitin is a hard, horn-like substance which is insoluble in acids and is dissolved only by strong alkaline solutions. We thus see that the insect has been provided by nature with an almost impregnable defensive armor. At the points where the plates overlap are the openings of the respiratory apparatus and it



COMMON RAT FLEA OF INDIA—MALE.



THE COMMON RAT FLEA OF INDIA—FEMALE.

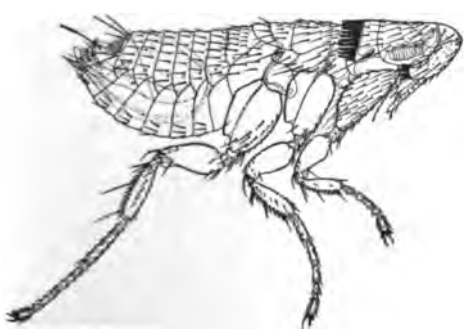
is through these that the flea breathes. These are twenty-four in number and are the only vulnerable points on the insect. In fact, almost the only way to kill fleas, if we except crushing and starvation, is by means of fine moist dust such as buhach which clogs the respiratory orifices or by poisonous gases.

Fitted over the tail like a saddle and protected by an innumerable number of fine bristles is the organ of smell, the pygidium. This is, roughly, triangular in shape and consists of a plate-like structure having a number of sensory pits which look as though they had been punched out. Immediately below this plate is a large respiratory opening which takes the place of a nostril. The air passing over the pygidium to this opening irritates the fine bristles, thus transmitting the sensation of smell. This organ is very necessary to the flea on account of the almost utter lack of tactile sense and he depends very largely upon it in hunting for food.

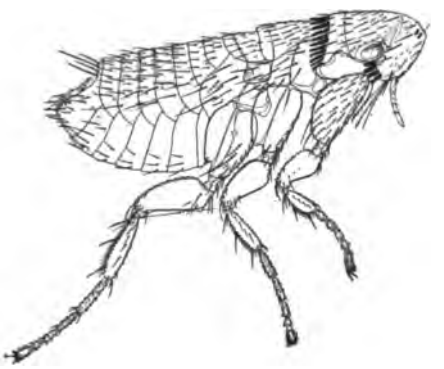
In common with the rest of the animal world, if we except mankind, the male is much more adorned than its better half, who is modestly arrayed in a neatly fitting suit of brown armor. The ladies are inclined to the petite, being perhaps three-fourths the size of the stronger sex. They far outnumber the latter, however, and hence in courtship the male assumes the passive role in a very lordly manner. With absolute lack of gallantry he ignores the other sex who must seek his society if she wishes a mate. It is very amusing to watch the efforts of a flirtatious flea to capture a beau, but having once seized hold of him she cuddles closely in his embrace, entangling herself in a determined manner in his spines.

The flea's head is armed with an elaborate biting apparatus which acts both as a weapon of offense and a means of securing food. On either side is a large triangular anchor which firmly grasps the skin of the victim and enables the insect to effectually insert the piercing organs. These consist of two lances each having a sharp spear-shaped head below which is a series of saw teeth. Between and above them is a sharp stylet. In biting, all three are inserted simultaneously, the saws working back and forth until a good opening is made and a flow of blood is started. When this is secured the stylet or epipharynx lifts slightly, the two lances coming together to make a groove in the space between them. The three organs thus form a tube through which the blood is drawn into the body of the flea by alternate rhythmical contractions and expansions of its sides. The flea feeds greedily and when very hungry takes a full hour for its meal. He is, however, more or less of a gourmet and moves about feeding here and there, leaving little red spots and irritability in his wake. On account of the long hind legs and the position of the biting apparatus he is obliged to stand upon his head while feeding.

Many of the fleas have the disgusting habit of depositing their excreta at the same time they secure their meal. The human flea is the worst mannered in this particular, and it is well established that it is in this way that he infects his victim with bubonic plague. Having eaten previously from a plague stricken animal he has taken into himself a very large



THE LITTLE BLIND MOUSE FLEA—MALE.



THE LITTLE BLIND MOUSE FLEA—FEMALE.

number of pest bacteria. These have been frequently found in the dejecta of the flea and may be deposited upon the skin of a healthy victim who subsequently rubs the irritated parts. The bacilli are thus forced into the minute wounds made by the flea, inoculating the victim with disease. This is not a matter of scientific speculation but has been thoroughly proved by accurate and pains-taking experiments in many parts of the world.

In the matter of vision the flea is far the inferior of his aristocratic cousin the fly. In most cases the eyes are very rudimentary and the sensation of sight is limited to the recognition of light. Objects cannot be determined at all and on account of the low grade tactile sense possessed by the flea he is dependent almost entirely upon the olfactory sense.

The flea is provided with six legs arranged in three pairs which become progressively longer as you go aft. There is nothing very remarkable about the first two pairs but the hind legs are the largest, longest and most powerful in proportion to the size and weight of the insect of any in the entire animal kingdom. The propulsive apparatus of the kangaroo is, in comparison, but a pitiful imitation. Provided with enormous hams and with feet armed with claws working on the principle of a cant-hook they are able to leap in a manner calculated to make the most bemedaled track athlete turn green with envy. The American amateur indoor standing broad jump record of 15⅞ inches was made by a fair co-ed after fasting four days. The running high, 7¾ inches, is also held by Miss Pulex Irritans. This family has representatives in all of the colleges of the Pacific Coast. Figuring on this basis in proportion to weight and body length a man would be able to jump over an office building one hundred and sixty-eight stories high, and in making such a leap would traverse over three-fifths of a mile.

The ordinary progression of the flea, however, is not so active or graceful. In fact, the walking gait is more or less of a shuffle. Sometimes indeed he lies upon his side and seems to swim along. He is, unfortunately, not provided with suckers on his feet as is his cousin, the fly, and cannot walk on glass any more than a man with hobnail shoes can dance on polished marble.

We have seen what a dangerous insect the flea is. It is a pest to mankind, not only on account of the annoyance which it occasions, sometimes amounting to actual illness, but also because of its transmission of the dread disease, bubonic plague. If this were all, the case against this pestiferous tribe would not be so bad, but the bacilli of leprosy have been found in the body of the flea and it is thought that they may also act as transmitting agents in the case of several of the trypanosomes and small worms.

The question which naturally arises is, how are we to rid ourselves of these ubiquitous and annoying insects. We have seen that they breed chiefly in dust and subsist in their young life upon organic refuse. A house kept absolutely free from dust should have few fleas. Coal oil or benzine will kill fleas and flea eggs, or where no objection to the odor obtains, naphthaline is most excellent for this purpose. The frequent beating of rugs and keeping out of dust are great aids, and if the house be cleaned by pneumatic suction apparatus, not only the fleas, but also their eggs are removed and destroyed. In India a unique application of the fact that guinea-pigs are natural flea traps has been made. It is well known that natives do not like to destroy life and are therefore very kind to pets. Each house in which plague has occurred or may occur is supplied with three or four guinea-pigs, and the natives are carefully instructed to inform the health authorities whenever these fall sick. They are then removed from the house and if found to have plague the premises are immediately subjected to a very careful cleaning. The guinea-pigs are, therefore, plague barometers. It is the common belief that a piece of fresh liver placed on sticky fly paper will attract large numbers of fleas, but this has not proved so in experiments. For outbuildings the use of chlorinated lime is to be specially recommended as a pulicide, that is, an instrument which kills fleas. Most important of all is the destruction of the host, the rat. Following the large plague war waged in San Francisco that city was practically free from fleas for

many months owing to the ruthless extermination of rats.

The question of the individual preference of fleas for persons has also received careful study. It is the popular belief that fleas prefer blondes to brunettes and ladies to gentlemen, but it has not been possible to prove this experimentally. Certain it is that they are equally kindly disposed to black or white guinea-pigs and several negroes are known whom the fleas use as a veritable haven. Cleanliness does not seem to be a bar to them, in fact, there seems to be some reason for the belief that they prefer cleanly persons, to those to whom the bath-tub is unknown. After all, the best that scientists can do is to take refuge in the well worn word "idiosyncrasy" which is equivalent to saying: "I don't know." There is still a vast amount of work to be done upon the interesting flea and much time and money have to be spent in the study of it. The Rothschilds have equipped and sent out expensive expeditions to secure fleas from rare hosts, while the British in India and Australia, the French in their Chinese provinces and the Americans on the Pacific Coast are all seeking after knowledge regarding this enemy to mankind and it may not be long before the results achieved by these various agencies will enable us to destroy forever this persistent disseminator of pestilence and death.

The Real Death

For I say this is death and the sole death,—
When a man's loss comes to him from his gain,
Darkness from light, from knowledge ignorance,
And lack of love from love made manifest.

—ROBERT BROWNING.

THE GREAT STATION OF THE PENNSYLVANIA RAILROAD. NEW YORK CITY.
Work on the interior is not yet completed.

BIGGEST TERMINAL IN THE WORLD

By P. HARVEY MIDDLETON

IN order that the metropolis might have a railroad station equal to its needs, beautiful in architecture and perfect in its appointments, a crowded city in point of population and variety of business has been swept from off the face of Manhattan. Wholesale purchases of real estate involving an expenditure of ten million dollars were made in order to obtain the site. The swarming inhabitants of four entire blocks were driven from their homes, and five hundred buildings, worth four millions of dollars, including churches, tenement houses, apartment houses, brown stone residences, saloons, stores, factories and restaurants were razed to the ground. Then came an army of laborers with picks and shovels and wonderful machinery to dig and blast the biggest hole ever dug in New York, forty feet deep and twenty-eight acres in extent—an excavation costing another five millions of dollars.

And now that big hole has been filled with the greatest railroad building in the world, the largest of the more than one hundred thousand stations of civilization. To build it and the tunnels with which it is connected cost the price of an empire —more than the combined sums paid by the United States for the Philippines, Florida, Alaska and Louisiana. One hundred millions of dollars! And all this that the barriers of the East and North rivers, which for so many years have hampered the movement and development of traffic in Manhattan, might be removed, and direct entrance be afforded to New York City without recourse to ferries.

This improvement of the Pennsylvania system is easily the most important work ever undertaken by a railroad corporation, and the most impressive tribute ever offered to the metropolis as the focal point of America. The new terminal station is one-third larger than the present largest station in the world—Liverpool Street Station, London, and one-half larger than the present largest station in the United States—South Station,

THE SHIELD METHOD OF TUNNEL CONSTRUCTION.
It is expected that all tunnels will be open to traffic by June 1.

Boston. Some idea of its mastodonic proportions may be gathered from the statement that you could put Madison Square Garden in one corner and the Waldorf Astoria Hotel in another corner and still there would be room in the great terminal for all the traffic it is designed to handle.

As will be seen from our photographs, the architecture of the building is severely classic, the exterior showing a Doric colonnade thirty-five feet high. It is in every way a radical departure from the average railroad station, resembling externally the baths of Caracalla in the days of ancient Rome. The turrets and towers and the lofty arch train shed usually associated with such a structure are conspicuous by their absence. The explanation of this is that the principal function of this station is performed underneath the streets. The frontage on the avenues is four hundred and thirty feet and on the streets seven hundred and eighty-four feet. The tracks are forty feet below the street surface and the station is divided into three levels.

The main entrance is on Seventh Avenue. This is for foot passengers only, and it leads to the main waiting room through an arcade two hundred and twenty-five feet long by forty-five feet wide, flanked by shops filled with wares of special interest to the traveler, who may here purchase all requirements for his journey. Two thousand persons may

HUGE WATER MAIN SPLIT IN TWO SECTIONS TO MAKE ROOM FOR SUBWAY TUNNEL.

do their shopping comfortably in this arcade. If the passenger is hungry or thirsty he will proceed to the farther end of the arcade, where he will find a restaurant, lunch rooms, and cafe capable of serving ten thousand meals a day.

At the corners of Thirty-first and Thirty-third Streets and Seventh Avenue are open pavilions through which carriages descend by a slight incline to the station proper, adjoining the ticket offices and baggage rooms. Apart from the main entrance, there are other convenient entrances and exits for foot passengers on all streets and avenues surrounding the building, including one from Thirty-fourth Street.

On the first level below the street is the station proper. Here is the general waiting room, the largest in the world, two hundred and seventy-seven by one hundred and three feet, and one hundred and fifty feet high. Within the marble walls of this magnificent apartment are located the ticket offices, parcel rooms, telegraph and telephone offices—twenty-four booths—and baggage checking windows, all so arranged that a passenger may proceed from one to the other seriatim with a minimum amount of exertion and without retracing his steps. Adjoining the general waiting room on the west are two subsidiary waiting rooms, fifty-eight by one hundred feet, respectively, for men and women, provided with seats, and opening into retiring rooms with lavatories attached.

When the passenger is ready to go to his train he proceeds to the concourse, an immense platform facing the twenty-one tracks, and forming a court yard three hundred and forty feet wide by two hundred and ten feet broad, roofed by a lofty train shed of iron and glass. Ten thousand persons can wait for trains on the concourse at one time without undue crowding.

ANOTHER TYPE OF ELECTRIC LOCOMOTIVE FOR USE IN THE SUBWAY TUNNELS.

AN ELECTRIC LOCOMOTIVE ON THE PENNSYLVANIA LINES.

Auxiliary to the main concourse and located between it and the tracks is a sub or exit concourse, sixty feet wide, which will be used for exit purposes only. This exit concourse is eighteen feet above the tracks, but is connected with the track level by two stairways and one elevator from each platform.

From it ample staircases and inclines lead directly to the street level. By exits alone the concourse is designed to get rid of one hundred and sixty-two thousand persons an hour, while all trains bring a maximum of only thirty thousand an hour.

The northern side of the station extending along Thirty-third Street, is assigned to the Long Island Railroad, into which trains will run from all points on Long Island by way of the East River tunnels. Ample entrances and exits are provided, so that this traffic can be handled independently of the rest of the station. From this section of the terminal a traveler can take a through car for Providence or Boston or any point "down East," arrangement for this service having been made by a loop running through the East River tunnel from Long Island, connected with the main line from New England. In the same manner the passenger can get to any point on Long Island without changing cars or crossing in a ferry.

The third level for the passenger is the train platform, about thirty-six feet below the surface of the street, which is so gradually reached that the descent is scarcely noticeable, and when reached the passenger is in the center of the station and boards his train without further walking. On the same level with the general waiting room the main baggage room, with four hundred and fifty feet of frontage, for the use of the transfer wagons, is located, covering the full area occupied by the arcade and restaurants on the plane above. The baggage is delivered and taken away through a special subway. From the baggage room trunks are delivered to the tracks below by motor trucks and elevators. The motor cabs will also be stationed on this level. The gates of the stairs descending from the concourse to the trains bear signs announcing the name, destination and the time of departure of the train on the particular platform where the stairs land.

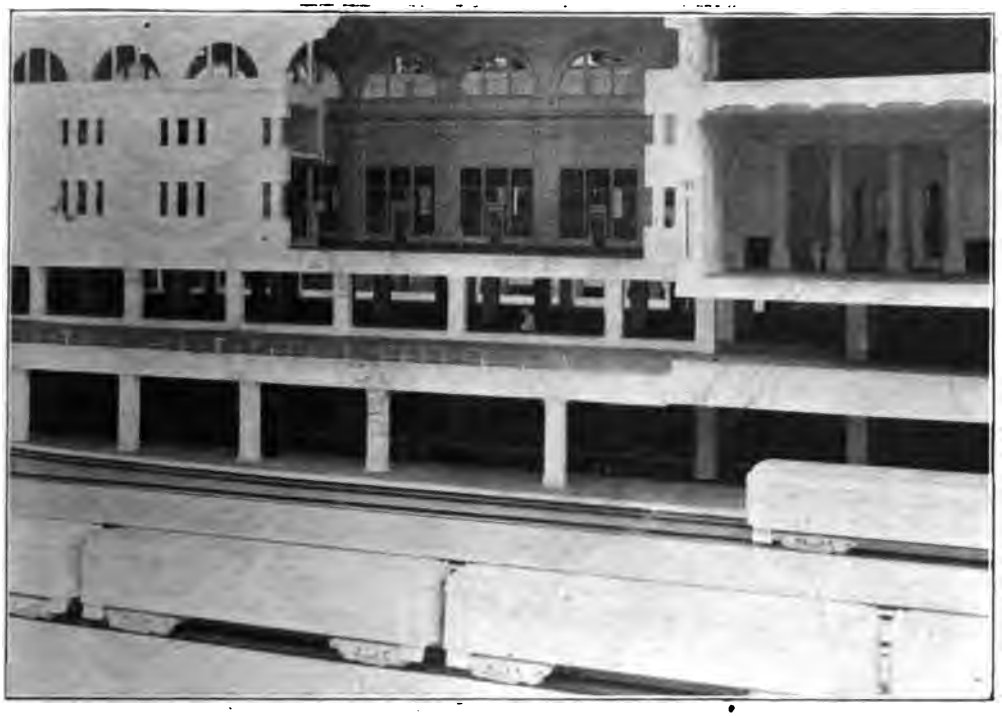
When the two tracks emerge from the tubes under the Hudson and reach the entrance to the station yards at Tenth Avenue they begin to multiply, and at Ninth Avenue, and extending into this station, the number has grown from two to twenty-one. There is also a reduction in the number of tracks leading out of the station yard to the east, to a total of four for the main line, passing under the city, and thence under the East River to the Sunnyside Yard on Long Island. The track surface of the station may be compared to two unfolded fans joined together at the open ends, the handle of one extending under the Hudson and that of the other under the East River. Within the station area, covering twenty-eight acres of ground space, there are sixteen miles of tracks. Through trains from the western side of the Hudson, after discharging passengers, will proceed to the Sunnyside Yard, on Long Island, where the trains are shunted, stored and cleaned, thus leaving the station tracks free of any idle equipment. Likewise, the westbound through trains

ROCK WORK IN ONE OF THE TUNNELS.

THE MAIN WAITING ROOM OF THE PENNSYLVANIA STATION.

made up at the Long Island city yard will pass through the station, stopping only to take up their quota of passengers. The numerous entrances and exits, independent of each other, greatly facilitate the movement of traffic, while the situation of the structure on two of the main arteries of the city makes all portions of Manhattan easily accessible. It must be remembered that this station is extraordinary in that the trains are fed to it through a tunnel at either end, each tunnel running under a river, presenting therefore a problem in engineering which has never before been met in the construction of a railroad terminal.

In November, 1908, the contract was awarded to the Westinghouse works for



A SECTIONAL MODEL OF THE NEW STATION.

the electrification of the vast terminal system from Harrison, New Jersey, under the Hudson River, through the tunnels under Manhattan and the East River to Jamaica, Long Island. One hundred electric locomotives, each of 4,000 horse power, and capable of one hundred and twenty miles an hour—the most powerful ever made—were called for in the original order. The dimensions of these locomotives are: length over all, sixty-seven feet, seven and one-quarter inches, total wheel base fifty-five feet two inches: height, top of rail to top of roof, thirteen feet one inch, total weight one hundred and forty-five tons.

Within the station and train shed is standing room for fully three hundred thousand persons, or a number equal to five armies like that of the United States forces. Engineers estimate that the accommodation will be equal to the maximum traffic of one hundred and thirteen thousand arriving and departing travelers per hour. As one statistician puts it, the entire population of the United States, Canada and Mexico could pass through its portals in a single year without inconvenience. "Were all the travelers who are to use the Pennsylvania Terminal in the course of one year," says this authority, "to form in line of procession, four abreast, the line would reach from New York to Panama, and it would require a period of three years to pass through the station, stepping at regular military pace."

THE CAR AND ITS INVENTOR—LOUIS BRENNAN.

SUCCESS OF BRENNAN'S MONORAIL

By J. HARTLEY KNIGHT

SOME time ago, when the device first appeared, an account was given in these pages of the gyroscopic monorailway invented and patented by Mr. Louis Brennan, of Gillingham near Chatham, Kent. The account in question dealt with the gyroscopic monorail in its model and experimental form. Since that time the inventor has been hard at work, and in November last invited a party of experts and newspaper men to a practical demonstration of a car forty feet long, ten feet broad, and weighing twenty-two tons. The demonstration was completely successful. The car, as constructed, is capable of carrying a load of from ten to fifteen tons, and possesses four wheels, which run on a single rail, secured on sleepers. It is claimed for the invention that it is capable of a speed of 150 miles an hour in perfect safety and without any perceptible vibration. Nothing like speed was actually attempted during the test because the length of straight track was but a quarter of a mile and the complete circle an eighth of a mile only in circumference. However, the speed

adopted amply proved that a perfect balance could be automatically maintained, even on the sharpest curves, as effectively as if the machine possessed wheels on each side.

The machine works with a petrol motor and develops its own electricity, but it can run equally well on power drawn from an overhead installation. Mr. Brennan gave generous acknowledgment of the assistance he had received in the form of subsidies from the British war office, and the Indian government.

"Everything," he said, "points to an increase in the dimensions of the monorail carriage. Unrestricted by the second rail, and, acting as truly with a carriage twenty feet wide as one with one of ten feet, there is no reason why the gyroscopic railway train should not be as wide as a modern ocean liner." He added that he could promise traveling at twice the existing speed; indeed the faster the carriage travels, the safer it is. The weight of each gyroscope employed in the car used for that particular demonstration was three-quarters of a ton, and its diameter three feet six inches.

ON TRIAL AT GILLINGHAM.

AS OPERATED WITH A LOAD OF PASSENGERS.

The only element of danger to the passenger is exactly the same as that which exists at present—from the explosion of the boiler of the locomotive behind which we travel to town. It was impossible, Mr. Brennan observed, in reply to a question, for the gyroscopes to stop suddenly—"it would take them an hour to lose their balancing force." With a full load the car can mount a gradient of one in thirteen; and "if one is prepared to sacrifice four tons of load it would run freely up a gradient of one in six."

It is understood that Mr. Brennan will construct monorail trains which are to be run in Kashmir as a first experiment. In a mountainous and difficult country, where an ordinary railway track could only be laid at enormous cost, the invention will be of peculiar advantage, as it can cross a ravine on a single strand of steel hawser and do many other marvelous things that no vehicle has ever done before. Mr. Brennan, it is interesting to note, holds the master patent in the invention, which is fully protected in thirteen countries and, amongst others, in Germany, where a monorail demonstration—with a machine constructed in Germany—was given before a body of experts on the nineteenth of last November.

The Chambered Nautilus

Build me more stately mansions, O my soul,
As the swift seasons roll!
Leave thy low-vaulted past
Let each new temple, nobler than the last,
Shut thee from heaven with a dome more vast,
Till thou at length art free,
Leaving thine outgrown shell by life's unresting sea!

—OLIVER WENDELL HOLMES.

THE NEW TELECTROGRAPH

By CECIL BEMBRIDGE

WHEN the Korn system of transmitting photographs and illustrations by wire was installed between London and Paris for the services of the Daily Mail of the English metropolis, though it offered a pronouncedly improved means of wiring illustrations over previously devised apparatus, several shortcomings were obvious. In the first place the apparatus itself was somewhat complicated, the process of transmission and reception was involved and somewhat uncertain due to the inherent caprices of the selenium used. The clear and definite transmission of a simple portrait, possibly the most frequently demanded requirement in newspaper operations in particular, proved difficult, and was a serious hindrance to the system.

Professor Korn continued his experiments for the purpose of eliminating these deficiencies, but so far the improvements have not proved completely satisfactory. The illustrations as printed in the newspapers bore strong evidences of having been extensively retouched and worked up and, as a result, much detail was lost. However, Mr. T. Thorne-Baker, the expert retained in charge of the photo-telegraphic department of the Daily Mail and Daily Mirror newspapers, set to work evolving a new system which has since been perfected with conspicuous success. This apparatus known as the "Telectrograph" is essentially electro-mechanical, the selenium cell is dispensed with, and in fact the whole process is appreciably simplified. The system has been installed in the London and Manchester offices of the papers, and is daily used for the transmission of the illustrations between the two centers over the telephone line—a distance of some two hundred miles—especially for the purpose of dispatching late pictures from the metropolis to Manchester for the late edition of the paper there, which is printed simultaneously with the London edition. The time saved by this service is from four to five hours, for the time required to dispatch the requisite blocks by rail from the engraving department in London to the north country publishing room, averages from five to six hours whereas by electrical transmission the same work is accomplished in sixty minutes.

The Thorne-Baker system has three fundamental features. These are respectively the flush surface transmission negative, the electric receiver, and the principle for ensuring clear and accurate transmission of the electric impulses.

THIS SCENE IS AS REPRODUCED BY TELECTROGRAPH TWO HUNDRED MILES AWAY.

The illustration to be transmitted is first photographed through a screen ruled seventy-five lines to the inch, upon a special plate comprising a sheet of lead foil prepared with a fish glue emulsion rendered sensitive to light in the ordinary way by means of bichromate of potash. Photographing through the ruled screen breaks up the picture into a series of lines or dots which act as insulators to the electric current. The subsequent development of this plate dissolves the soluble portions of the sensitized fish-glue emulsion so that a certain amount of re-

THE TELECTROGRAPH RECEIVER.
Electrically sensitive paper on drum.

lief is produced, the light sections being represented by the insoluble parts of the emulsion and the dark portions by the flat bare surface of the lead foil foundation. This negative is then given a flush surface by inserting it between two steel plates and subjecting it to hydraulic pressure. This presses the insoluble portions of the fish glue emulsion into the lead foil, giving the negative a smooth flush surface. In this operation it will be seen that the Thorne-Baker differs widely from similar systems practised upon the same general principles, as with a gelatine emulsion, the negative is left with its relief surface, and the electric circuit is made and broken by the needle point of the transmitter traveling over the dots.

The Thorne-Baker negative, thus obtained, is wrapped round the cylinder of the transmitter. This section of the apparatus closely resembles the Edison phonograph, there being a spiral feed arm parallel with the drum, with which engages a kneaded nut of the transmitting arm. This spirally threaded shaft is also threaded seventy-five lines to the inch. The cylindrical drum is electrically driven at the speed of thirty revolutions per minute. The steel tracer or contact piece, which corresponds with the needle of the phonograph, travels vertically down the picture making seventy-five such movements to every inch and follows the lines of the screen ruling, crossing the horizontal lines which are likewise ruled seventy-five lines per inch. The current flows through the drum and needle, the circuit being completed and broken each time the glue dots pass between the needle and the drum, the intermittent impulses passing into the telegraph or telephone wires. The periods of the impulses are governed by the extent of the contacts corresponding to the gradations of light and shade of the picture. In order to prevent sparking in the make and break, a variable condenser is placed across the pointer and the drum.

The variable electrical impulses thus dispatched from the transmitter are received at the other end of the line and passed into a special sort of transformer to be reinforced, whence they pass into the needle of the receiver, and trace the image upon an electrically sensitive paper attached to a revolving drum. This latter is similar to that of the transmitter and revolves exactly simultaneously therewith. The receiving sheet of paper is treated with certain chemicals so that each time the current flows a black dot is impressed upon the paper. The current is very minute, averaging about half a milliampere. By means of deliquescent salts the paper is kept moist and conductive, and the record thus obtained is absolutely permanent in character. Consequently, when the transmission is completed, an exact replica of the original is obtained with all its gradations of light and shade, and experience has shown that it is excellent for newspaper illustration printing.

In the first experiments considerable trouble was experienced by the oscillating currents set up in the telegraph wires, which completely spoiled the results, but the inventor has eliminated this disadvantage by passing a timed, damping oscillating current through the instrument in the reverse direction to the received current. With regard to speed, thirty revolutions per minute of the

drums has been found the most satisfactory, but such can be safely increased to about one hundred and twenty revolutions per minute. So far as regards the ruling of the screen, seventy-five lines per inch has been found to be approximately the limit for the negative, but in the case of the newspapers with which it is used, this is closer than is absolutely necessary, the illustrations themselves being prepared with a screen of fifty lines per inch for reproduction. A picture measuring eight by five inches can be transmitted in about ten minutes and one slightly narrower in nine minutes.

The inventor has also perfected an application of the same idea to wireless telegraphy, an installation of which is in service at the office of the Daily Mirror at the Shepherd's Bush exhibition in London. The line installation, as illustrated and described above, is now in daily use between London and Manchester. Its success upon this two hundred mile stretch has proved so completely successful that arrangements are being completed for its operation between London and Paris. Portraits, landscape photographs, wash and line drawings can be handled with equal facility.

COTTON IN CALIFORNIA

By C. L. EDHOLM

THE successful launching of the cotton industry in the Imperial Valley is the latest and most important business venture in that part of our country which has developed so many big and profitable "propositions,"—southern California.

With a known yield of more than a bale to an acre and indication of a steady average production of one and one-half bales to an acre, this reclaimed desert valley at once takes rank as a cotton area to be reckoned with. That the ranchers thereabouts have faith in the new crop is evidenced by the 1,200 acres now planted in cotton and a judicious estimate of between 15,000 and 25,000 acres to be planted in 1910. The ginning of the first bale took place in October, 1909, and was made the occasion of an enthusiastic demonstration by the residents of El Centro. A few weeks later, November 6th, 1909, the first carload of Imperial cotton, forty-three bales, was shipped from that town, consigned to the California Cotton Mills in East Oakland, and the return of more than $2,500 from this first carload gave tremendous impetus to those engaged in the new industry. Thirty more carloads will follow it during the season.

Practically the entire area of the valley is suitable for the production

THE COTTON FIELD IN SEPTEMBER.

PART OF THE FIRST CROP.

of this staple and the region has various advantages over the South, which may mean the difference to the producer between success and failure. The dreaded boll weevil is unknown in Imperial, and it is stated on good authority that there is no danger of invasion from the pest as it cannot live in that climate. Drought need not be feared, as the water supply can be regulated; there are no destructive rainstorms to injure the crop and no frost to hinder the picking.

A good market for the cotton products is near at hand, and already the prospects of a mill in the valley are excellent. The cotton seed oil industry is open to development there, the city of Los Angeles alone using three hundred carloads of the oil every year, which is worth a million dollars. Experiments are being tried meanwhile with cotton seed as a fodder for dairy stock, with encouraging results.

A most interesting item in connection with this latest Imperial project is the growing of the long-fiber Egyptian cotton, which the United States imports to the value of about $15,000,000 per annum. Hereafter it is expected that the bulk of that fifteen million will stay at home, helping to develop our own Southwest, as that is the one section of America where it can be grown. The yield is good, so far, but the imported seed does not do as well as that which has been acclimated.

What the addition of an important cotton area means to the United States may be gathered from the data recently given out by one of the biggest firms in this country dealing in that staple:

Cotton enters into the manufacture of more articles of commerce today than any other commodity except steel. Eliminate cotton and the stoppage of spindles and looms would be but a trifle compared to the paralysis that would visit countless other industries.

The railroads of America consume 250,000 bales of cotton annually. Cotton duck is the basis of the airbrake hose; of enameled ceilings, the plush chairs are of cotton, the "leather" seats are of cotton.

Automobiles require about 290,000 bales annually for the manufacture of tires and about 35,000 for the manufacture of "leather" seats and cushions.

More cotton is used each year to harvest and market the grain crops of the world than would be required to clothe the inhabitants of a large

city. Electricity, powerful as it is, cannot get along without cotton. Millions of miles of copper wire annually owe the perfection of their insulation to cotton yarn or tape of cotton cloth. The armies of the world today are clothed in cotton cloth—khaki—or something similar. This country alone requires about 5,000,000 yards of eight-ounce khaki cloth annually for its army. The navies and merchant ships of the world use more cotton duck today than was required in the days of sailing vessels. Millions of yards of cotton cloth are used by the tobacco industry for growing tobacco under shade and making bags for smoking tobacco.

Cotton bags have displaced barrels to a great extent in the shipment of sugar, salt and flour.

Cotton is used in the mining and marketing of coal. About 15,000,000 yards of cotton duck annually are made into coal bags.

About twenty million yards of cotton duck are made into overcoats with blanket lining, to take the place of heavy wool and fur garments in the American and Canadian Northwest. Thousands of bales annually are required to make cotton duck to place around the asbestos sectional covering in which the steam hot water pipes of fireproof buildings are enclosed. Cotton blankets have displaced woolen blankets in many important markets of the world.

Cotton cloth has taken the place of wall paper in thousands of modern homes.

Cement companies use about 8,000,000 yards of cotton bagging annually.

The government requires about 4,000,000 yards of cotton duck annually for coin bags.

Millions of yards of duck, forty-six inches wide, are used annually for the purpose of filtering oils.

THE COTTON FIELD IN LATE OCTOBER.

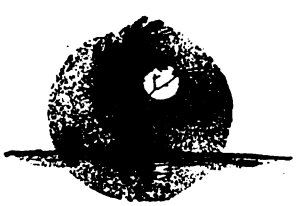
Cotton duck is the basis of rubber belting and all kinds of hose. Sales to these branches of the trade amount to 50,000,000 yards annually.

Millions of yards of cotton cloth are used in large cloth signs and advertisements.

More cotton is used in "linen" shirts and collars than linen. Mercerized cotton goods to the extent of hundreds of millions of yards sell in competition with silk.

Cotton is used to a greater or less extent in all but the most expensive of woolen fabrics.

These items furnish a few of the reasons why the world needs 3,000,000 bales more cotton than it did five years ago, notwithstanding the fact that new markets have not been extensively developed and the world's population has shown no sudden increase.



GRABBING THE MISSISSIPPI

By HENRY M. HYDE

THAT the Mississippi River shall be turned into a great ship-canal—bi-secting the continent, putting Chicago on the sea-coast, tying together the Great Lakes and the Gulf—is a magnificent dream which a great many people are working to realize. Governors and legislatures of the valley states have approved it; great associations of commerce have called upon Congress to take action; the people have passed large bond issues in its aid. Yet the great water-way remains still a dream; even its future establishment is doubtful. A dozen practical difficulties stand in the way. Army engineers report unfavorably. President Taft advises caution and delay. Great business interests block the project in a hundred ingenious and devious ways.

Meanwhile—and that without either doubt or delay—the Mississippi River is at various points along its course, being turned into a mill pond for the production of electric water power by great private corporations. If Congress and the authorities at Washington find themselves—for whatever reason—unable to do anything in the direction of making the Father of Waters a highway of commerce, they should at least see to it that the underlying rights of the public are protected as against the "vested interests" of the great power companies.

If, when the time really comes to open a deep water way from St. Paul to New Orleans, it is discovered that a dozen corporations have made great investments along the river, which interfere with the proposed work, it will be difficult—and may prove practically impossible—to carry the great project to success. What is needed now is a comprehensive plan, to the outlines of which all present and future river improvement work, public and private, may be fitted.

To those only accustomed to the Mississippi as it flows sluggishly between high dirt levees on its course to the Gulf, it will doubtless be a surprise to learn that in the upper river from Keokuk, Iowa, to Lake Itasca, there are a score of places where great water power plants can be successfully established.

The present great installation is being made by the Keokuk and Hamilton Water Power Company at the foot of the Des Moines rapids, at Keokuk, Iowa. In the twelve miles from Montrose, Iowa, to Keokuk, a series of rapids carry the water of the river down more than twenty-three feet towards sea level. At the foot of these rapids preliminary work has just begun on the construction of a solid concrete dam, thirty-five feet wide at the bottom of the river—which here runs over a bed of limestone. The dam will stretch out in a splendid curve for a distance of over six thousand feet to the Illinois shore. The top of the dam will be thirty-five feet above low water mark. Behind the dam the river will be backed up for a distance of forty miles and the present turbulent rapids will be transferred into a great quiet lake from two to three miles in width.

At the foot of the dam, on the Iowa side, a huge power house of pressed brick and steel, nearly two thousand feet in length, will be erected. It will contain forty or fifty generators of forty-five hundred horse-power each, working on a vertical shaft as do the generators at Niagara.

Up to 1877 it was necessary to unload all freight bound up or down the river when Keokuk was reached and carry it around the rapids. In that year, after spending five million dollars in its construction, the government opened a canal with three locks by means of which steamers were enabled to get from the upper into the lower river, and *vice-versa*. As an incident of the building of the present enormous power plant this government lock will be entirely cov-

SITE OF THE BIG LOCK IN THE DAM AT KEOKUK.

ered by the impounded waters, but it is a condition of the permit given by the government to the power company that the latter shall erect, at its own expense, a new and larger canal for the passage of boats around the rapids. The new canal is to contain only one lock and both time and expense will be saved by steam-boats using it, in comparison with the old canal.

The estimated cost of building the dam, power house and new ship canal and in installing the necessary machinery and equipment, is between ten and fifteen millions of dollars. At a minimum it is expected that one hundred thousand horse-power will be developed and that this will be easily salable at twenty dollars a horse-power per year, thus assuring its projectors an exceedingly handsome income on their very large investment. Possible future development at the foot of the Des Moines rapids may raise the total horse-power developed to two hundred thousand.

Hugh L. Cooper, who has been identified with water-power developments at Niagara and elsewhere, has been working on the Keokuk project for six or eight years. Part of the power developed by the Des Moines rapids he expects to send, over copper transmission wires to St. Louis—one hundred and fifty miles away—where it will be used in running street cars and for manufacturing purposes.

Keokuk and other cities along the Mississippi will also be supplied with

MIDDLE LOCK OF DES MOINES RAPIDS CANAL AT KEOKUK.
A section of the $5,000,000 government works which will be destroyed to make room for the overflow.

GOVERNMENT WORKS AT THE LOWER LOCKS OF DES MOINES RAPIDS CANAL.

power and it is expected that many of the sleepy old river towns will speedily develop into thrifty and bustling manufacturing centers.

That there are other opportunities for profitable power development along the great river is made clear by the following statement by Alton D. Adams, the well-known hydraulic and power engineer.

"The Mississippi River falls 1,462 feet in its course of 2,296 miles to the ocean," says Mr. Adams. "The average descent of 0.64 foot per mile is so small that there would be little favorable opportunity for useful power production if the fall was evenly distributed along the entire course of the Father of Waters. Fortunately, however, some two-thirds of the fall in the river bed is concentrated in the upper third of its length, and in this upper third falls and rapids of considerable height alternate with nearly level stretches of the stream. As a result, a number of power sites with substantial heads of water are available for development.

At Keokuk, 1,450 miles from the mouth of the Mississippi River, its normal level is only 477 feet above tide water, so that its average descent from that point amounts to only 0.33 feet per mile to the Gulf. Going up stream from Keokuk to Lake Itasca, the head waters of the river, the distance is 846 miles, and the increase of surface elevation is 985 feet. In this upper part of its course the average fall of the Mississippi is thus 1.04 feet per mile, or three times the rate of its descent between Keokuk and the Gulf. Two long stretches of quite different slopes may be noted above Keokuk. One of these extends from that city to the mouth of the Minnesota River on the Mississippi, a distance of 493 miles, and the other stretch is from the

LOWER LOCKS OF GOVERNMENT CANAL.
This property will be submerged when the dam is built.

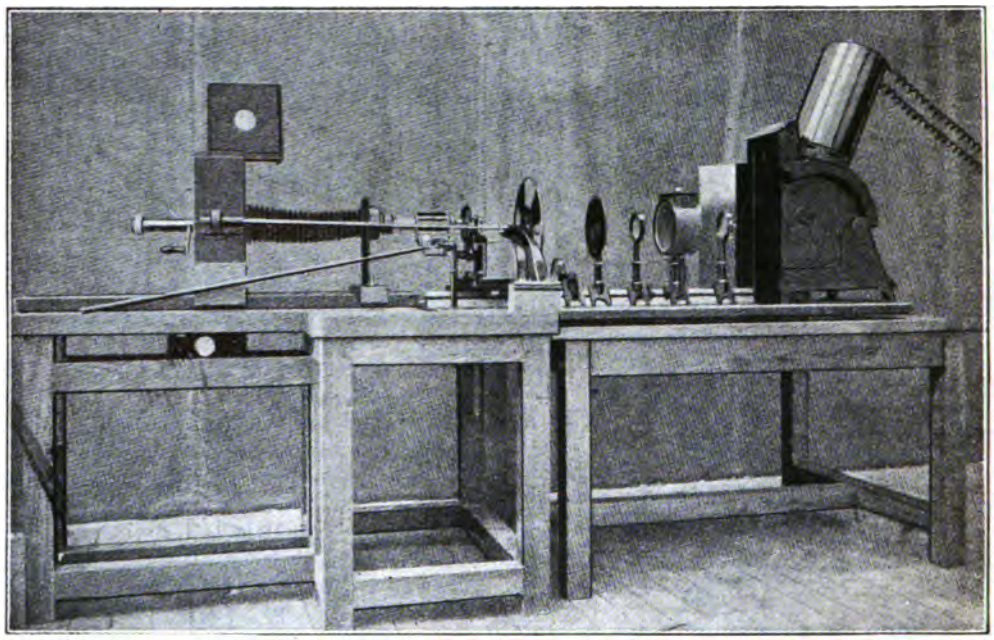
RAILROAD TRAVELS ALONGSIDE OF CANAL WHICH WILL BE SUBMERGED THIRTY-FIVE FEET BY THE BUILDING OF THE DAM.

mouth of the Minnesota to Lake Itasca, a distance of 353 miles by the river. From Lake Itasca to the mouth of the Minnesota River the total fall of the Mississippi is 774 feet, or an average of 2.47 feet per mile. Going down stream from the mouth of the Minnesota River to the foot of the rapids at Keokuk, the Mississippi falls 211 feet, or 0.43 feet per mile. Of this 211 feet, the stretch of river 137 miles long, from the head of the rapids at Le Claire, Iowa, down past Rock Island, Illinois, 16 miles below, and on to the foot of the Keokuk rapids falls 85 feet, or 0.62 foot per mile. It is in this 137 miles of river, that by far the best, if not the only, opportunities for power development on the 1,943 miles of the Mississippi south of the mouth of the Minnesota River occur. From Le Claire to Rock Island the Mississippi goes down 20 feet in 16 miles, over a series of rapids. In the 12 miles from Montrose, Iowa, to Keokuk, rapids carry the river down 23 feet. Of the above named fall of 85 feet in 137 miles, it thus seems that 43 feet, or nearly one-half, is concentrated in two lengths of river that aggregate only 28 miles.

These water heads of 20 and 23 feet, available along 16 and 12 miles of river respectively, are sufficient for the development of great powers with the large volume of water flowing in the Mississippi.

Above the mouth of the Minnesota River the power sites along the Mississippi are much more numerous than those below. The Minnesota discharges into the Mississippi River at Fort Snelling, five miles below Raspberry Island in the latter, opposite the business section of St. Paul. In this five miles the Mississippi falls as many feet. Along the next nine miles of its course, that is from the mouth of the Minnesota to the crest of St. Anthony Falls, the increase of surface elevation on the Mississippi is 106 feet, corresponding to an average descent of 11.77 feet per mile. Of this total drop, 30 feet takes place between the crest and foot of St. Anthony Falls, at Minneapolis, and the remaining 76 feet is distributed along the nearly nine miles of rapids where the river flows between nearly perpendicular cliffs some 200 feet high. Power developed by St. Anthony Falls has been an important factor in the flour milling industry at Minneapolis, and a part of the drop of the river along the rapids is devoted to the supply of energy for electric cars in the Twin Cities. Above St. Paul the drainage area of the Mississippi River, excluding that of the Minnesota, is 19,735 square miles, and the drainage area above St. Anthony Falls is nearly the same. From March to November, inclusive, in 1897, the maximum discharge of the Mississippi River, at St. Paul, was 71,275 cubic feet per second, in April, and its minimum discharge was 5,060 cubic feet per second, in November. Between April and September, in that year, the minimum rate of discharge dropped from 32,390 to 9,150 cubic feet per second.

Even in Minnesota, 2,000 miles from the Gulf, the volume of the Mississippi is sufficient, in connection with its available heads, for the development of numerous large water powers, and enough has been said to indicate the value of all.



INSTRUMENT FOR MAKING PHOTOGRAPHS OF MICROBES.

MOVING PICTURES OF MICROBES

By EDFRID BINGHAM

IT is a question today which is the more wonderful work of the Creator —the infinitely big or the infinitely little. Our remote ancestors, standing at the doors of their huts and caves, were awed by the mountains, winds, sunsets, stars and all the immensity of immeasurable space. We, in our turn, are likely to be as stunned by marvels of nature so secret and small that we are only beginning to discover them after thousands of years of human curiosity and experience. And before the Lowells and Pickerings shall have learned the story of Mars there may be epics written on the Trojan war waged in a drop of blood.

All sorts of fantastic speculations are permissible after the amazing experiments with the ultra-microscope and the cinematograph lately brought to a successful issue by Dr. Jean Comandon and his associates of Paris. The revelation of this achievement came during the recent sessions of the French Academy of Sciences, when the learned men gathered there were astounded and delighted by the glimpse given into the world of bacteria by Dr. Dastre, a professor at the Sorbonne, who first operated before any public audience the apparatus of Dr. Comandon. A little later the young physician himself, at a meeting in the establishment of Masson Brothers, publishers of medical books, put the Parisian public in possession of the full significance of his discovery.

That discovery, or invention, is nothing less than the application of the cinematograph, or moving-picture apparatus, to the world of microbes. Dr. Comandon photographs and reproduces a scene in a blood vessel or speck of decaying tissue just as the showman photographs and reproduces a dog-fight, a comical domestic quarrel, a shipwreck or the flight

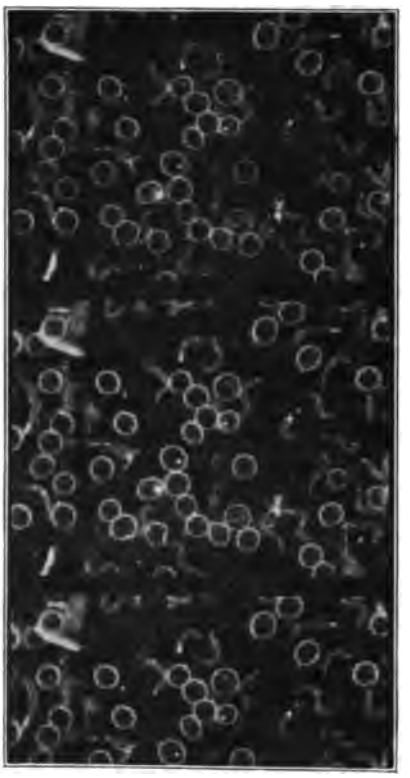
of an aeroplane. The imagination can find nothing in the daily life of human beings more thrilling and wonderful than some of the scenes presented to the silent and awe-struck spectators of the performance at the house of Masson Brothers. They saw on the screen, in that room all darkened and hung with black draperies to heighten the effect, first an animated scene enacted in the delicate network of capillaries, or tiny blood-vessels, in the foot of a frog. Innumerable red globules struggled with one another like a frightened crowd of people trying each to be the first to escape from something through a narrow passage. The white globules, those carnivorous animals of the little world that circulates in our blood-vessels, attached themselves to the red globules, enveloped them and devoured them. Everything was in motion; the tiny creatures lived, struggled, fought; it was the old story of all life on this planet—the strong driving, oppressing, devouring the weak; eternal and pitiless battle for existence. And it left a curious feeling in the hearts of the spectators.

FIVE IMAGES OF A DROP OF BLOOD.
Consecutive moving pictures.

There followed a peep into the blood-vessel of a bird, where little dart-like creatures, twisted as so many cork-screws, dashed about in their headlong career. These were the spirochetes gallinarum—parasites which kill the fowl in certain regions of South America, and which are near relative to well-known microbes that afflict human beings with their terrible ravages. Among the healthy red globules dashed these murderous savages of the blood, with movements like serpents up and down the screen of the cinematograph. They attached themselves to one another, flung off, attached themselves again, whirled, darted, danced like veritable cannibals before a feast. Then suddenly one of them would dash out, leap on a red globule, pierce it with incredible swiftness. Sometimes the spirochete would remain imprisoned in the red globule, despite its struggles to escape; other times it emerged after a frantic agitation. Then here and there appeared a white globule, moving slowly through the mass, and when it encountered a red globule that lacked the speed of most of its fellows the white attacked and devoured the red and moved ponderously on its way again.

Next came a drop of the blood of a mouse which had been infected with the microbe of that sleeping sickness which

ravages the animal life and even the human life of interior Africa. These were eel-like creatures, provided along their entire length with undulating fins. These too attacked and consumed the red globules in the blood. And here again were the large white globules, which indicated that the mouse had eaten some fatty substance which gave birth to them in the process of digestion. Other scenes were presented, showing various kinds of microbes, some provided with claws, with tusks, with tentacles, with strange members that enable them to move and cling and prey upon the healthy elements in the blood, many of them so infinitesimal that a cubic millimeter held two millions of them. And to make them visible in these wonderful moving pictures required their enlargement by 10,000 to 20,000 diameters.



THREE IMAGES OF A DROP OF BLOOD.
Part of a film in actual use.

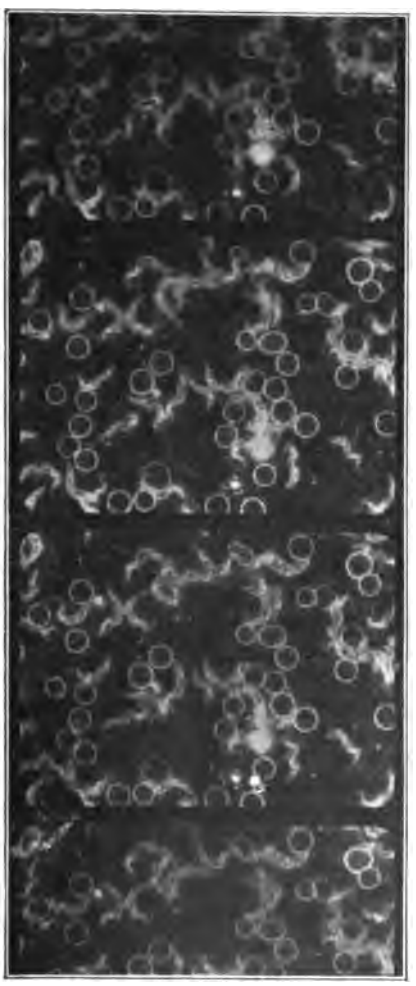
This brings the story back to its beginning—the microscope and its successor, the ultra-microscope. In the ordinary microscope the objects examined are seen by transparence—that is to say, a light beneath the objects passes through or around them and leaves them visible and magnified as dark spots on a luminous background. But by this method the light penetrated into the tube of the microscope, interfering with the vision; and, besides, if the microbes sought for were transparent, as many of them are, they were not distinguishable from the field in which they lay. Resort was had to coloring them to make them visible, but this method had the very depressing disadvantage of killing the microbes with the aniline coloring matter before the microscopist could begin his work of examining them.

The solution of this difficulty was the invention of the ultra-microscope. In this wonderful instrument two things are to be noted. In the first place the light is thrown on the object, not from beneath it, but laterally, from a lamp placed at one side of the apparatus. In the second place a prism of glass, or parabolic condenser placed beneath the object to be examined, receives the light, and throws it on the object refracted in such a way that none of the rays enter the tube of the microscope. The object of investigation appears then under the lens like objects that are luminous in themselves, like the planets, for instance, which receive laterally the rays of the sun and therefore stand out, as it were, on the background of the sky. The microbes under the ultra-microscope, instead of being barely perceived on a luminous background, appear as bright spots on a dark background, and the work of the microscopist is advanced by a tremendous stride. Many bacilli that were invisible before are now brought within reach of the investigator.

Dr. Comandon had long sought to obtain a nearer and more precise vision of the world of bacilli. He is a true enthusiast, who says, "All those who have labored with the ultra-microscope know under what beautiful aspect appear certain preparations, and they have, without doubt, regretted not being able to preserve these images almost fairy-like and often of the highest scientific interest." He worked a long time trying to photograph these images under the lens of the microscope, but he invariably found that, even with the utmost rapidity

possible in the use of the camera the outlines of the microbes were blurred in the photograph and the life was no longer there. He pays a tribute to his master and friend, Dr. Victor Henri, for having suggested to him the use of the cinematograph to catch this delicate and fugitive life and to bring it into the realm of careful and leisurely study. Pathé Brothers, the great cinematograph makers of Paris, put their laboratory and factory at his disposition, and after two years of experimenting he was able to throw on a screen the moving pictures presenting the microbe world revealed in the full tide of its activity.

The apparatus as it is now perfected consists first of an electric arc lamp of 30 amperes, placed at one end of a solid table, at the other end of which is the cinematographic camera and its machinery. Next to the lamp is a series of lenses for concentrating and modifying at will the rays of the electric light, and a diaphragm by which is cut off all the excess of the light beyond the rays centered upon the microscopic appliance. Then comes a disk of which the use will be explained later, and finally the microscope placed horizontally, with its eye piece at the lens of the cinematograph. The concentrated ray from the lamp is caught by the mirror of the microscope, thrown on the object to be photographed, and then, by means of the parabolic glass is diverted at an angle that prevents its entrance into the tube of the instrument. The machinery of the cinematograph is set in motion at the rate of 16 exposures per second, and the movements of the living microbes are preserved on the band of films. By the time they appear on the screen they are magnified as much, in some instances, as 30,000 diameters.



FOUR IMAGES OF DROP OF BLOOD OF A MOUSE.

One of the greatest difficulties encountered by Dr. Comandon in his experiments was the intense heat developed by the electric lamp. A few instants of exposure to such rays of light is sufficient to kill the microbes which inhabit the preparation under the microscope. To remedy this, many appliances were tried without success before Dr. Comandon thought of a disk made to rotate very ingeniously in the path of the rays. This disk is composed of sections open and closed alternately, and being synchronized with the cinematograph, it makes an alternating current of light, so to speak. The microbes are subjected thus to intermittent exposure, being under the heat only one-thirty-second part of a second each time, corresponding with the succession of films. To moderate still further the heat of the rays they are made to pass through a little reservoir of cold water between two of the lenses near the lamp. When the images have been taken on the band of the cinematograph the process continues precisely as in the case of preparing a street scene for the edification of an assemblage in a cinematograph theater.

"I do not insist," said Dr. Comandon, "on the manner in which the matter shall be prepared for

photographing with the microcinematographe. This subject has already been well treated by Dr. Gastou. It suffices to know that in general the drop of blood or infected matter is placed on one glass plate and another is pressed down firmly upon it till the preparation is spread out very thin between the two layers of glass. The uses to which we have put this microcinematographic process already are considerable. We were never before able to count the living inhabitants of matter because of their mobility: for example, the mobile particles of the blood which Müller has named hemokonies. Investigation with the ultra-microscope has shown that these animated particles have as origin the alimentary fats. An animal having absorbed a repast rich in fats, its blood swarms, two hours thereafter, with these hemokonies, which gradually disappear. By taking rapidly a great number of successive photographs, it is possible to count these lively particles, and to trace their growth and disappearance in the process of digestion. In the same way we watch the process of coagulation of the blood and the movements of every sort of microbe and, in short, every tiny process, healthy or malevolent, that takes place in the blood, in living tissues, in diseased flesh and in cultures specially prepared. I believe the microcinematograph will greatly enlarge the spheres of investigation of the biologist, the chemist and the bacteriologist."

"The consequences of this discovery," said Professor Dastre, of the Sorbonne, "are incalculable. All the movements microbian, all the movements brownien, so ill known today, will be studied now with a precision indescribable. In bacteriology we shall have, instead of fleeting glimpses into the world of bacilli, records fixed by which we shall study at our leisure. In short, many scientific questions that have baffled us are likely to be resolved, thanks to this new method. Nature conceals much from us in the realm of the infinitely little, and I am prepared to hear of astounding discoveries and perhaps of successful battles with hitherto unconquered epidemics."

But this is not all, for Professor Pizon of the Lyceum Janson-de-Sailly, and his associates M. Vies and Mlle. Chevroton, have applied the cinematograph in another marvelous way. If there are natural phenomena which are produced with too great rapidity for us to seize their movements, there are others too slow for us to grasp their details. A plant is larger today than it was yesterday, but who has seen it grow? The bud of today is the rose of tomorrow, but though the wonder takes place under our eyes it is a mystery still. Cell growth of all kinds takes place at a pace too moderate to be synthesized. The experiments of Professor Pizon have been given little publicity up to the present time, but it is known that he and his associates are working on the principle that if the cinematograph can analyze very rapid movements by reduction of their speed in reproduction it can also synthesize very slow ones by increasing their speed in the picture. It was announced at the recent meeting of the Academy that Professor Pizon had succeeded in thus reproducing at appreciable speed all the curious transformations of that favorite subject of the biologist, the sea urchin. It is thus clear that the cinematograph will be employed in embryology, that branch of science which deals with the origin and development of organisms, and even in the study of parthenogenesis, that branch of biology which deals with the still impenetrable mysteries of reproduction from the female without the intervention of the male. All these possibilities explain in some small way the enthusiasm which Dr. Comandon's and Professor Pizon's discoveries have aroused among the scientific men of France and of other countries of Europe.

LAYING RUBBER-ASPHALT IN A STREET OF MARSEILLES.

RUBBER AND ASPHALT FOR ROADS

By WILLIAM T. WALSH

IN France, where they are constantly experimenting with all known and every new sort of paving, an asphalt-rubber combination is now being tested, in such cities as Paris, Lyons, and Marseilles. Europeans have been influenced, since the days of the Romans, by the magnificent roadways left by those sturdy civilizers. Modern wear and tear on roads, by motor, carriage and heavy wagon is far greater than in the days when the legions of Augustus or Vespasian, the chariots of the conquerors of distant peoples, or the hoofs of couriers' horses, passed over the Imperial highways that bound together Gaul and Persia. Present-day exigencies demand even more perfect roads than were required eighteen or twenty centuries ago.

Asphalt is perhaps one of the very best road-building materials in use today. The facility with which this substance can be molded, the rapidity with which it hardens, the comparative ease of repair, testify to its merits. But asphalt has disadvantages, and decided ones at that. It is costly, special plants for heating the powder and skilled workmen to lay and roll the heavy substance being required. Hence, small towns cannot well afford to make use of asphalt, and even many large cities hesitate to make use of this valuable substance despite its obvious merits.

Now in combination with rubber—rubber-asphalt,—asphalt loses many of these disadvantages. According to M. Mazerolle, the French engineer, who presided at the International Road Con-

TAMPING DOWN THE RUBBER-ASPHALT.

gress held in Paris not long since, excellent results have been obtained with the new material, and its chief advantages are the facility with which rubber-asphalt can be laid and the few and simple utensils required for laying it. Best of all it can be applied cold.

To bring about this combination of rubber and asphalt, the two substances are placed together in a special mixing apparatus. The asphalt is introduced in the form of a fine powder, the rubber swollen and softened by a solvent. The resultant material is a brown powder of a darker color than the original asphalt, and requiring only compression to settle and harden quickly. The surface then takes on a lighter tint, and, after a few days' exposure to the air, becomes a greyish white.

Much thinner layers of the asphalt-rubber material, than of asphalt alone, can be used, inasmuch as the mixture forms a harder substance. This is an important recommendation in addition to the advantage of ease and facility in preparing and laying.

The new preparation stands the test of time well. If a section of the pavement is taken up after long usage it is found to be equally hard at base and surface. A striking contrast with the older material is shown when rubber-asphalt is repaired. It suffices to polish the fractured edge of the old layer where the mending is to be effected, in order that the new layer may adhere. Then fresh material is mixed and prepared on the spot, is laid down cold, and is compressed quickly into place. Traffic may be resumed immediately on the completion of the work. Moreover, only a few minutes are required for the entire process.

NEW BILLIONS IN PUBLIC LAND

By WM. ATHERTON DU PUY

THE United States government has been for three years quietly classifying its public lands to determine what of value they contained and, to the general surprise, has discovered a wealth that mounts into such figures as to be no less than appalling. On the despised lands of the West the government experts have unearthed coal fields that compare favorably with the richest ever found in the east. They bring back reports that make necessary a redrafting of the coal maps of the nation and upset entirely the current idea of the location of the nation's fuel supply. Nothing tells the story so graphically as the new schedules setting forth the amounts of coal contained in the states that produce most of it. A list of the nine states containing most coal and their estimated tonnage follows:

North Dakota .....500,000,000,000 tons
Wyoming .....424,000,000,000 tons
Colorado .....371,000,000,000 tons
Montana .....303,000,000,000 tons
Illinois .....240,000,000,000 tons
West Virginia .....231,000,000,000 tons
Utah .....198,000,000,000 tons
Pennsylvania .....133,000,000,000 tons

The setting forth of this scientific data comes like a thunderbolt to those who have always been accustomed to look to Pennsylvania and adjacent states as the center of the coal supply of the nation. The experts show how the government should realize five billion dollars in the advanced prices for which these lands will be sold. Yet coal is but one feature of their findings. There are, for instance, on public lands oil fields worth millions yet unestimated. There is enough phosphate to maintain the fertility of all those acres that grow wheat and which depend on this soil element for their vitality. There are such incidental possibilities as enough waterpower to turn the spindles of the nation present and future and 30,000,000 acres of desert land that may be irrigated and made worth $100 an acre. But above all the coal values stand out in such proportions as to be staggering in size.

TRIANGULATION STATION USED IN SURVEYING PUBLIC LANDS.

TYPICAL COAL MINING PLANT IN THE GREAT WEST.

The discovery of these facts came about through the scheme of land classification upon which the Geological Survey has been working for the past three years. The men of this service have become the official prospectors of the government, sent out with a little more than the burro and grub stake of the pioneer gold seeker. Their purpose has not been to stake out claims for their own aggrandizement but to determine where on the government's land lay the things of the earth that bore particular value. They were to take stock of the possessions of the government in the West and place values upon them. Strangely this had never before been done. The government has owned a domain that reached originally across a continent with but a fringe on the east in private ownership. It was the most valuable possession that the world has ever known. Yet it has been given away to whosoever wanted it and no account kept. Recently the opinion has grown that it was not being disposed of wisely. The prodigal has stopped near the end of his means and determined to dispose of what remained in an intelligent manner. He must count the money as a basis of that disposition.

The classification of the remaining lands is but a counting of the remaining money. It was begun in 1906 when President Roosevelt became alarmed at the great number of land frauds exposed and the shown tendency of coal lands, water power sites and such to be concentrated under monopolistic control, and withdrew from entry pending an investigation, all such lands. His first blanket withdrawals covered 60,000,000 acres, 15,000,000 more being soon added and smaller withdrawals have since followed irregularly.

A CORNER-STONE LANDMARK.
The basis of the land surveys of the section.

Outside of this there were vast stretches including the greater part of the land in many states that came under the classification scheme but for which there was no need of withdrawal, because there was no tendency toward unlawfully obtaining possession of it.

The classification force was immediately put into the field under M. R. Campbell, coal geologist of the Geological Survey. It later grew into the Classification Board, destined to become famous, headed by A. C. Veach, an intrepid young expert. The force was chiefly made up of civil engineers and geologists, young men and active, with great capacity for work and care for in-

MAP OF OUR OIL FIELDS.
The government lands in the West have been withdrawn from settlement.

COAL MAP OF THE UNITED STATES.
Compiled by U. S. Geological Survey.

finite detail. The word they are bringing back is a surprise to the most sanguine. They find in Wyoming beds of coal eighty-four feet thick in places. For a hundred miles one seam runs with a thickness approximating thirty feet. In Colorado, Utah, and Montana, there are fields greater in extent than those of West Virginia and surpassing in quality those of Illinois and Indiana. Lost in the wilds of Arizona there are coal deposits on government land that even the great producers have not yet thought to monopolize. Beneath the great forests and the glacial gravel of Washington there are fields yet uninvestigated. The possibilities of future discovery are without limit, yet there is coal enough in sight to supply the nation for generations after the Eastern supply is exhausted. It belongs to the nation and therefore to the people. Through classification, the lands bearing it are to be placed in a condition where they may be used only to the greatest benefit of the whole people. In being so placed they (the coal lands) will bring into the treasury and thereby save the people in taxes $4,000,000,000, or fifty dollars each for the 80,000,000.

There have been for the past three years an average of twelve or fourteen parties working regularly on land classification. These parties are made up of five or six men each, each party complete in itself and working independently. A block of land being withdrawn until the nature of it can be determined, a classification party is sent to do the piece of work in hand. The chief of it is a geologist, as is the first assistant. The other members may not be technical men, but a preference is shown for young fellows out of college with some knowledge of the work in hand.

The life is that of the camp in the wilds. There are all the hardships of roughing it, of fighting the elements and the battles of maintaining water and provisions in sections far removed from the haunts of man. The weather is severe in the high mountains of Montana, Wyoming, Colorado, and, in fact, in all of the Rocky Mountain area. Yet camp is usually maintained until the first of December when the hardiest parties are forced into the lowlands and occupy the mid-winter season in the labor of getting their data into shape.

But the actual classification is a striking example of the value of applied science. The geologist, because of his ability to determine what is under ground by the surface outcroppings and indications,

is accomplishing such results as have hitherto been largely a matter of theory. A party entering upon the task of determining the amount of coal in a given block of land, has as its first work the establishment of the old government survey and the running of the lines in order that the findings may be located. The geologists must also be civil engineers that this may be done without calling in additional help. It is the simplest part of the work.

MAKING RECORDS IN THE FIELD OF THE CLASSES OF LAND ENCOUNTERED.

The placing of the coal deposits is then undertaken. The mere examination of a given small piece of land may show little of its coal possibilities. There may be deposits hundreds of feet underground of which there are no surface indication. The land must be studied with relation to all the country roundabout. The Western country is mostly broken. Great canyons cut through it and great cliffs reveal its stratification for thousands of perpendicular feet. Following a mesa in any direction will lead to these canyons and cliffs where nature has sunk the prospect shafts for the geologists. In these cliffs the strata of the surrounding country is plainly revealed. Examination of them will show the coal outcroppings. There may be a dozen seams of it at different depths. Each of these seams may be traced for many miles, often entirely around the table land. From its quality and thickness, an estimate may be made of the amount of it under the table land. If it is horizontal its depth from the top of the mesa may be easily determined. If it dips either up or down, its depth at any point may be estimated. If it shows a tendency to grow thicker or thinner the degree of the change at any point may be estimated. The seams of coal appearing for twenty miles about the land in question must be carefully examined and their bearing upon the question in hand determined.

JOINTED COAL IN BALLARD'S MINE, UTAH.

Yet the object of the classification is not to make more money out of the lands but to guard against their fraudulent acquisition. Great coal companies have for a generation been fraudulently absorbing vast tracts of land. The chief means of doing this has been in filing on it through "dummy" entrymen as agricultural land. The law stipulates that the homestead filing is good only on non-mineral land. The oath of the applicant, however, has always been taken as to whether or not the land was mineral. If he stated that it was not mineral land and some other private individual did not contest his claim, the patent was in the course of time granted.

So it happened that much valuable coal lands was taken up as homesteads.

In some of these cases the applicant was honest and actually unaware of the fact that coal was under his land, just as the farmers of Illinois found themselves owners of coal mines after living a century on homesteads that had been secured from the government in just this way. It quite often happens that a bed of coal may underlie a plain twenty miles across and at no place appear at the surface. The edges of the plain being cut by canyons will, however, reveal seams of coal. Geologists or coal operators seeing this become aware that there is a great bed of coal under the plain. The latter are likely to induce dummies to file on the land, advance them the necessary money to procure patents, take mortgages on the land, and foreclose as soon as the title is obtained. In this way the whole plain goes into the hands of the big operator.

Government scrip juggling is another notorious method of fraudulently obtaining land and has probably resulted in the unlawful separation of Uncle Sam from more of his holdings than anything else. Scrip is issued by the government to individuals who have owned land in the National forests or on reservations which the government desired to take back. The scrip was given in lieu of this land and entitled the holder to enter any non-mineral government land remaining untaken. The scrip was transferable. It was bought by the great corporations who desired to absorb lands and under its authority dummy entrymen filed upon and obtained title to great quantities of selected valuable land. Old soldier's scrip was also used on a large scale in perpetrating these frauds. The law allows the old soldier eighty acres as a homestead in addition to that which may be procured by any other settler. It does not require residence on his part and is negotiable. The coal companies take the directories of the pension office, procure the addresses of the pensioners and make them offers for this scrip. It is so bought to cover many thousands of acres. None of these filings are good, however, except on agricultural land and were the coal lands classified and set aside for mineral entries only the fraud could not be perpetrated.

The estimates of the profits of classification are, however, entirely apart from this prevention of fraud and the unestimated money saved here should be added to the figures given. The known saving comes through the valuation of the lands. Under the old regulation coal land within fifteen miles of a railroad was valued at $20 an acre, and that more than fifteen miles distant was valued at $10 an acre. This price should have been paid for land which was obtained for nothing as a homestead or for scrip. Even where that price was paid it was ridiculously insignificant as compared with the prices that are being set where the quantity of coal is known under the new regime.

It was the realization of such facts as these that caused President Roosevelt to first withdraw all lands suspected of having coal on them. The Interior Department and the Geological Survey were immediately set to work to determine the nature of these government lands that an intelligent idea might be obtained as to the proper disposition to be made of them. Secretary Garfield and Director Smith began studying the law and found that there had long been on the statutes a regulation authorizing the classification of these lands. Strangely, the law creating the Geological Survey in 1879 defined as the primary object of its creation the classification of government land. Its activities had, however, been turned into more scientific channels in its early life and its original purpose had waited for more than a quarter of a century.

A corps of engineers and geologists were immediately put into the field. They are there today pushing the work toward completion. The task is about one-third through and those lands that have so far been examined have been thrown again open to settlement but in accordance with the classification. Much of it has been found to have no mineral and has been restored as agricultural land. Much of it contained coal and may now be purchased from the government as coal land but on a basis entirely different from that of old. In place of the old flat price there is now a figure based upon the actual mineral contained. The price of the government on this basis is governed by quantity of the coal, its quality and the proximity to a railroad.

OIL FIELD ON GOVERNMENT LANDS WITHDRAWN FROM ENTRY PENDING LEGISLATION.

In some cases the coal is figured as low as half a cent a ton. The maximum price is but three cents a ton despite the fact that royalties in this section are regularly eight cents a ton. In any circumstances the lands are sold at bargain prices to the purchaser.

Yet this means many millions to the government. In the six months between April and October last, for instance, the government agents classified 13,000,000 acres of land. Under the old flat price if paid for and obtained without fraud this land would have brought $47,000,000, but under the new classification it will bring $141,000,000. This means that the government will realize a profit of $94,000,000 from the work of its classification squad for a single six months aside from the money saved through frauds prevented and the benefit of a more just distribution of its land. Under the estimate of 80,000,000 acres of land the old minimum price of $10 an acre would have brought $800,000,000. Under the new schedule where the land is priced in proportion to the amount of coal it contains it will average $60 an acre and will bring $4,800,000,000, a net profit of four billion dollars, which is an amount of money so big as to be beyond the comprehension of man.

So far there have been classified 34,000,000 acres of coal lands. The work is being actively pushed in Wyoming, Colorado, Utah and Montana, in all of which states there are extensive deposits. These states are to be completed first because coal operations are most active there. As soon as classified the lands are put back on the market and, strange to say, they sell more rapidly at the advance price than they did at those that formerly prevailed. There is the opinion of the government geologists that certain given amounts of coal are contained and many claims are bought on this claim alone.

The work is done by townships, sections, quarter-sections and forty-acre tracts. The country is investigated with reference to even this smallest division and individual acreage prices are placed on each. Maps are made by townships and the coal contained in every part of it indicated. Then the price at the given ton rate is figured and placed on the map. These prices are wide in range, being nothing in many places and climbing from that to $500 and more to the acre. The maps are filed in accordance with a modern card index system. One may go to these files, find any given piece of land that has been classified, obtain the government report upon the amount of coal it contains and the price at which it may be bought. The plan is to extend the work until it covers in this detail all the land yet belonging to the government. Then those lands when mineral will be sold at prices that are at least proportionate to their value. Those lands that are agricultural, dry land or otherwise, will be disposed of as such and so on to the end.

When the classification is completed the results will become a part of the records of the land office. The sections covered by local land offices will be supplied with plots of the lands coming under their jurisdiction and applicants

GOVERNMENT COAL LANDS.
Four veins of coal lie beneath the surface.

for land will be able to see these maps. With this evidence to the contrary an applicant will not be likely to enter a homestead filing where the land is classified as coal bearing. He may do so and contest the original findings of the experts. This will lead to an investigation to determine which is right and if a mistake has been made in the original classification the applicant may yet secure his homestead. Aside from this the classification may prevent honest mistakes on the part of the applicant who may not be able to determine whether or not there is coal under the particular land he wants.

It so happens that there are great tracts of oil land in Wyoming, California, Utah, Oregon and possibly other states. When the laws were framed covering the disposal of mineral lands the development of oil fields was unknown and there is consequently no law readily applicable to them. The most convenient makeshift was the law governing placer claims. This statute stipulates that location may be made only upon discovery. The discovery of oil, however, rarely takes place until after a well has been drilled and so, if the statute is strictly applied, an entry cannot be made and the claim remains unprotected until the well is completed. Another manner of securing oil land has been through homestead filings and false pretense is here again necessary. In the face of these facts the oil lands of the West amounting to nearly 4,000,000 acres have been withdrawn from entry until an adequate law can be framed for their disposal.

A more striking example of the value of the classification of lands and the advisability of withdrawing them where there is danger of their being inadvertently obtained is shown in the case of the phosphate deposits in Wyoming, Idaho and Utah. Phosphate beds are very rare and those of the world are threatened with exhaustion. Yet phosphate is a vital quality in the soil without which it will not produce such cereals as wheat. Therefore it is generally in demand for use in fertilizers. When the deposits in the West were discovered an attempt was made by a German company to get control of them with the idea of shipping their output abroad. This despite the fact that the time is approaching when the wheat fields of this country will be desperately in need of the fertilizer. President Roosevelt upon discovering the plans for exporting this ma-

CAMP OF GOVERNMENT AGENTS.

terial immediately withdrew the lands and they are also being withheld pending legislation that will prevent this great need of the soil from being sent abroad. It is planned to lease or sell the deposits with agreement that the output shall not be exported and so retain the phosphate for American soil.

Present day developments of the classification idea shows very plainly the loss that the government has sustained in the past through lack of it and the monopolistic tendencies that have developed. In coal lands alone, for instance, the government has disposed of 40,000,000 acres in the West. Practically no return has been received and the lands are owned by large corporations. The mass of it was given in grants to railroad companies that built across the great plains. There was no appreciation on the part of the government of the value of the land given away in this manner. Much of the remainder was fraudulently obtained and the government is now fighting to recover coal lands valued at $50,000,000 in a single state. Quite naturally the best lands were taken first. They must have been of great value for that which was picked over and remains is being classified as being worth $60 an acre on the low valuation of the government. Even this price would place its value at $2,400,000,000, which might have been saved had the work been begun at a sufficiently early date. But the greater benefit would, of course, have resulted in placing the land properly in the hands of the people through preventing fraud.

"The public land problem," says Director Smith of the Geological Survey, "resolves itself into, first, the determination of the best use to which the public domain can be put, and, secondly, the disposition or reservation of the land now belonging to the nation so as to assure that use." Quite naturally the government has not been able to measure up to the problem for it has never known the nature of its lands nor their greatest utilitarian possibilities. It has never before taken stock of its wealth. It is today in its classification and valuation of lands taking the first business-like step in its whole handling of the land question. It has lost a third of its far western domain by its delay but will save two-thirds by at

last taking the necessary step. Aside from this it will have come near a solution of the vexing land fraud questions of the West. There are half a dozen small pieces of legislation that are needed to clear up the whole situation and these are well understood in departmental circles and will probably soon be on the statutes. The public land situation has presented a dark picture in many of its aspects but this discovery of unsuspected governmental wealth and the effective steps that are being taken to make the best use of it seems the happy ending to the story.

OUTCROP OF COAL ON GOVERNMENT LAND IN MONTANA.

The surface must be studied also. Every prospect hole or mine shaft is opened up and the coal therein studied with relation to the land thereabout. When there are none of these they must be sunk. Every advantage of the prospector is made use of. The badger and the gopher, burrowing animals of the West, are the original prospectors. Many a rich coal mine has been located because of the particles of mineral brought to the surface by these animals. Where the badger shows coal to exist a shaft is sent down and the value of the find determined. The coal may be beneath a layer of sandstone. The sandstone is much easier followed than the coal and wherever it appears in the country roundabout the layer of coal is likely to be beneath it and it is consequently investigated.

From the surface outcroppings the geologist can determine the formations for hundreds of feet underground. The stratification of the Rocky Mountain region is much bent and twisted and broken up. Yet the geologist knows the degrees and angles of those twistings and breakings and can determine the sub surface with wonderful accuracy. It is through this knowledge of infinite detail and through the taking of infinite pains that he is enabled to set value on the coal lands. These determinations place the classification on a basis of knowledge and furnish information for the guidance of the miner for years to come. Such is the difficult work of the young men of the Survey.

CANNEL COAL OVERLAIN BY BITUMINOUS COAL.

Unromantic

"ANYTHING romantic about their wedding?"

"Not a thing. She can cook, and he has a job."—*Kansas City Journal.*

According to Agreement

HICKS: "You don't mean to say you got the better of Gabbie in an argument?"

WICKS: "Yes; I told him if he'd give me two minutes to present my side, without interruption, I'd let him talk for an hour."

HICKS: "Well?"

WICKS: "Well, when I had talked through my two minutes I jumped on a passing trolley car."—*Catholic Standard and Times.*

Gentle Girl

"THERE is such a thing as being too considerate and tender-hearted."

"What's the trouble now?"

"My daughter refuses to boil the drinking-water for fear of hurting the germs."—*Scissors.*

Quite Likely

THE judge waved aside the trembling prisoner's plea.

"You need not try to move me. Why, I can see the rascal in your eyes!"

"Your honor," expostulated the man, "I think that is a personal reflection."—*The Circle.*

Ready John

"Jo[illegible]," exclaimed the indignant other half of the combination, "do you see this blonde hair on your coat just where one of the buttons is missing?"

"Yes, my dear," meekly replied John.

"Well, sir?" she queried, in a tone that demanded an explanation.

"Oh, it's all right," answered the head of the house, as he winked at the cat. "I put the hair where you found it for the purpose of attracting your attention to the button which has been missing for nearly a week."—*Chicago News.*

The Way It Works

"THE time to save is when you're young."

"That's all right, but a fellow doesn't earn anything till he gets well along and then it costs more to live."—*Boston Herald.*

Not Far Wrong

SEPTIMUS—"How is your little girl, Mrs. Smith?"

MRS. SMITH—"My little *boy* is quite well, I thank you."

SEPTIMUS—"Oh, it's a boy! I knew it was one or the other."—*Brooklyn Life.*

Gimeracks

GILES—"My wife can drive nails like lightning."

MILES—"You don't mean it!"

GILES—"Sure I do. Lightning, you know, seldom strikes twice in the same place."—*Chicago News.*

Happy Outlook

MILTON—"Gibson doesn't seem to be getting rich at poultry raising."

BILTON—"No; but he says his hens have taken to eating their own eggs, and he has hopes that they'll become self-supporting.—*The New Yorker.*

Another Discovery of the Pole

AND thus spoke Sewell Ford:

It was a dark night. A man was riding a bicycle with no lamp. He came to a cross-roads, and did not know which way to turn. He felt in his pocket for a match. He found but one. Climbing to the top of the pole, he lit the match carefully and in the ensuing glimmer read: WET PAINT.—*Everybody's.*

Mollycoddles

FIRST CHAUFFEUR—"War is absurdly sentimental."

SECOND CHAUFFEUR—"Yes, they actually go back and bury the dead."—*Chicago Tribune.*

The Philosophy of Economy

WISE—"Don't get foolish just because you've had a little money left to you. You'd better be economical now."

GAILEY—"Ah, it's too hard."

WISE—"But if you don't live economically now you'll have to later."

GAILEY—"Well, it isn't so hard to be economical when you have to."—*Catholic Times.*

God Knows

THE inspector asked the boys of the school he was examining: "Can you take your warm overcoats off?" "Yes, sir," was the response. "Can the bear take his warm overcoat off?" "No, sir." "Why not?" There was silence for a while, and then a little boy spoke up: "Please, sir, because God alone knows where the buttons are."—*St. James's Gazette.*

An Efficient Hand

J. W. DVORSKEY and brother of Iowa City were in town Thursday. J. W. is our trustworthy county recorder, while his brother is one of Uncle Sam's efficient postal mail clerks, and it was he who threw the mail sack from the flyer that struck our fellow citizen, E. D. Jones, several months ago.—*Oxford (Ia.) Leader.*

Nothing New

"CONGRATULATIONS! I hear one of your daughters is engaged. Which one it is?"

"Get out! It's only Bessie again!"—*Meggendorfer Blaetter.*

The Bright Young Man

IT was on a Superior street car, and the handsome young man had arisen from his seat as the pretty girl entered.

"Oh, please!" she twittered, "don't get up. Keep your seat, pray do!"

The young man looked at her admiringly.

"Well, that's mighty sweet of you, little girl," he said, "and I hate to turn down a bid like that. But, honest, I've got an important date, and here's where I get off. Call me up by 'phone some day, won't you?"

When we left the car she was still blushing.—*Cleveland Leader.*

His Political Bonds

"I DIDN'T know young Snobberly took any interest in politics."

"Nonsense! He doesn't."

"But I just heard him talking for the past ten minutes about 'party ties'."

"O! he means white lawn bows."—*Philadelphia Press.*

A Much-Married Lady

"I WANT a license to marry the best girl in the world," said the young man.

"Sure," commented the clerk, "that makes thirteen hundred licenses for that girl this season."—*Puck.*

CORN OF A NEW KIND

By ROBERT FRANKLIN

A NEW kind of Indian corn has been brought to this country recently from China. It was sent by a missionary, from Shanghai, to the Department of Agriculture. It is so entirely unlike any variety of maize known in America as to suggest the notion that possibly botanists have been wrong in the belief they have so long entertained that Indian corn was originally a native to the American continent exclusively.

In all likelihood, however, the early progenitors of this variety were carried by some means from America to China centuries before Columbus was born. So much is inferred from the fact that, by what is known about plant life, it must have required a very long period of time to develop into so distinct a type under cultivation.

PIGMY CHINESE MAIZE.
Two views of the same plant.

It has many peculiarities. In the first place, the plant is a dwarf, not growing higher ordinarily than about four feet. The ears average five and a half inches in length only, with sixteen to eighteen rows of small grains. These grains are found, when cut in two, to have a curious waxlike consistency, and the starch they contain is very much different in character from any starch with which the Western nations have been acquainted hitherto.

The new Chinese maize is likely to prove valuable for breeding purposes. Already it has been successfully crossed with big-grained varieties, with a view to increasing the size of the kernels. Some of the crosses are expected to "take after" the Oriental plant in at least one feature which will render them useful for cultivation in the dry regions of the Southwest.

In that part of the country the "silks" of maize plants are liable, at the time of flowering, to be burned up by the hot desert winds before the grains have a chance to be pollinated. But in the Chinese corn an erect arrangement of the leaves, which are all on one side of the stalk, and the devolpment of the silks in the angle where the leaf-blade joins the sheath, offer a protected place in which pollen can settle and accomplish fertilization before the silks are exposed to the air.

The whole structure constitutes a most beautiful adaptation to prevent the drying out of the silks before pollination—the overlapping blades catching all pollen that is blown against the upper part of the plant, and allowing it to settle in the channels at the base of the blades, where it accumulates. The silks are then pushed into this accumulation of pollen, and thus become fertilized.

POPULAR · SCIENCE & MECHANICS SUPPLEMENT ·

HOW WE LOOK ON TOP.

The photographs on this page were taken from above the figures that appear in them. The effect is odd, as it is seldom we get just these views of each other.

AN AUSTRIAN ROADSIDE INN.
Beautiful spot the motors have found out.

A ROAD IN THE ISLE OF MAN.
Picturesque bit of motor-race course.

SOME BEAUTIFUL ROADS

THE four photographs on this page were not taken, so much to show beauty in the scenes, as to give an idea of the courses of motors. Three of the scenes were taken in the Isle of Man, which is in the Irish Sea, off the northwest coast of England. The fourth is an Austrian view.

The motorists are doing much to find out the beauties of lands that have been little known to travelers. They are becoming the pioneers, too, in touring and the pictures that are brought back from some of the runs made through countries, heretofore little penetrated, spur the desire to see further and to hunt out new rustic beauties.

WAITING FOR THE START.
Motor race on road lined with trees and green fields, in the Isle of Man.

A STRETCH THAT'S HARD TO BEAT.
Another Manx road over which the motors make a merry pace.

A CONTRAST IN DOLLS

HERE is an opportunity to compare odd types of modern and ancient dolls. In London, Eng., recently was held a doll show at which were exhibited some unusual playthings, in form of dolls of many nations. Two of the most interesting are pictured on this page in the lower corners. The other figures are of ancient dolls found in Greece and Rome, which have been gathered and placed in the British Museum.

GREEK DOLL IN BRITISH MUSEUM.

ROMAN DOLL IN BRITISH MUSEUM.

GREEK DOLL IN BRITISH MUSEUM.

DUTCH DOLL.
Exhibited in London Doll Show.

DOLL FIGURE OF GIRL.
A trinket that belonged to Greece.

ORIENTAL DOLL.
Exhibited in London Doll Show

KITE-FLYING IN CHINA-TOWN

THE Chinese are such clever kite makers that it seems a wonder they did not invent the airship. The complicated kites which they make require such precision and science in their adjustment that it is not considered beneath the dignity of grown-ups to rig and fly them.

The specimen shown herewith was photographed by the writer in the "China-town" of Los Angeles, California, where the Chinese retain many of their Oriental ways. The twenty-six discs of bamboo and silk paper of which it is composed are held together by a delicate system of fine cords and balanced by the projecting bamboo sticks on both sides. The kite flyer told me that he had worked on it for an entire week. Could an American boy make one in a month?

This is called a dragon kite and it does bear some resemblance to the fairy-tale monsters, for it is colored bright red above and white below, and wriggles and squirms like a mythical flying serpent. The first disc, which represents the head, is furnished with a grotesquely horrible face and the eyes are made so that they revolve in the wind, giving it a fierce and life-like expression that is truly terrifying.

CHINESE KITE-FLYING.
The Orientals are not satisfied with plain, flat kites, but must make fanciful ones.

THE PORPOISE SCHOOL

MORE than fifty of these odd creatures can be counted in the photograph herewith, which was taken with a small kodak near Newport in southern California. As fully two-thirds of the school are under water, and only a part of the number on the surface were within range of the camera, there may have been five hundred or so in the school. The porpoise is disliked by fishermen, as it preys on the fish. There is no prospect of a "bite" for some time after Mr. Porpoise has made one of his raids. Of interest to boys is the fact that the main usefulness of the porpoise is in the manufacture of base-balls. The proboscis, of a rubber-like elasticity, is used for the center or core of high-priced balls. It is a curious thing that a school of the queer fish so often announces itself by commotion in the water.

A BIG SCHOOL OF PORPOISES.
In this particular photograph the disturbance of the water would indicate the presence of many more fish than those showing their back-fins. It is a peculiar trait of this sea-dweller that it makes such a commotion and shows itself in this odd fashion. The question whether it is on the hunt or only at play has not been settled.

ENGLISH MODEL HOUSES

AN experiment is being tried in London in providing model houses for workingmen of small wages at a suburb known as Hampstead Gardens, a short distance from the main part of the city, but within easy riding distance. These houses were built by a syndicate, which expects to make them pay a moderate profit on the investment, the aim being not, however, a matter of profit so much as to provide good homes for working people away from the crowded tenement districts of the big city. These houses are cottages of three to four tenements each and rents range from about $2.50 to $3.00 per week, in American money. They are built of cement plaster, and are provided with open plumbing and all modern conveniences such as are common to American tenements or flats. They are a great advance over the average workingman's dwelling in English cities, are light, clean, sunny and are easily reached for a low rate of fare.

A hint might be taken, from this effort and what it has accomplished, for application to American suburbs to be built for workingmen.

A ROW OF MODEL ENGLISH WORKINGMEN'S COTTAGES.
These range in rent from $2.50 to $3.00 per week, which does not seem high for a suburb of London.

INSTRUMENT FOR HUNTING COMETS

HERE is an instrument called a "comet-finder." Its name sufficiently describes the purpose for which it is intended. Being provided with a very wide aperture, it is able to sweep large areas of the heavens rapidly. The instrument, of course, is a kind of telescope. The one in the photograph is the property of the U. S. Naval Observatory at Washington. To see through it, when watching for a comet, one peeps through a hole in the hub of the adjusting wheel at the side—a prism of glass conveying to the eye the light rays which enter at the top.

A COMET-FINDER.
Instrument used to discover new wanderers in space.

WHY DO COOKED FRUITS TASTE SOUR?

IT is well known that fruits that taste sweet when eaten raw, taste sour after being cooked. Everybody knows, for instance, that preserved fruits require a very large quantity of sugar in order to make them palatable. An explanation for this was found when extensive chemical experiments established that cooking changes the cane sugar into less sweet inverted sugar and releases all acids.

NEW CENTRIFUGAL PUMP THAT ROTATES IN AIR. View shows device open.

TWO-BARRELED CANNON. Made during Civil War, now in a park at Athens, Ga., a curiosity.

MID-AIR CENTRIFUGAL PUMP

MANY various devices have been used of more or less merit for pumping water. The photographs show a pump invented by Edward S. Nicholas, which operates on a new principle. All piston and centrifugal pumps rotate the piston or runner in water; this runner rotates in air. The runner is made of hollow arms; each arm is slightly bent inward at the end to cause it to "suck" or draw while rotating in air. The arms are curved the same as in other pumps. Water thrown from the runner falls through the air into the tank below the pump case. As the tank fills, the air is compressed in the case; the air pressure drives the water through the discharge pipe which leads from the bottom of the tank. The friction developed by rotating in water is avoided. It takes power to rotate machinery in water and the friction is increased as the head of water is raised. It is claimed this pump shows a high efficiency.

THE NEW PUMP CLOSED. A unique principle in pumps is used in this device.

MOTOR-CAR ON RAILS. An English Railway uses this car regularly for passenger service.

UNUSUAL WATER-TOWER

A REMARKABLE concrete water tower has recently been completed in Brussels, Belgium. It is built of concrete blocks; is one hundred and forty feet in height and of 280,000 gallons capacity. It is to be one of the features of the International Exposition of 1910. Inside is a winding stairway which leads up to a height of what is practically six stories. The interior space is divided into rooms which will be occupied by workmen during the time of the Exposition. The central space in the tower is occupied by the water tanks and standpipe.

Exteriorly, its appearance is unusual and it will be an attractive exposition feature.

CURIOUS WATER-TOWER BUILT FOR EXPOSITION IN BRUSSELS.

A STRANGE SUIT FOR DIVING

A MECHANIC of the Royal Italian Marine, Mr. J. Restucci, has made very successful experiments with a new system of metallic diver's suit, which he has invented.

The Restucci suit is made of iron about four-tenths of an inch thick, and of dimensions such as could contain a man standing erect. It is cylindrical, with its upper portion almost spherical. This section is plentifully furnished with tools with which to work at the bottom of the sea.

There are some very ingenious parts to this machine. It is constructed with two bronze arms, very similar to the human arm. The right member is capable of

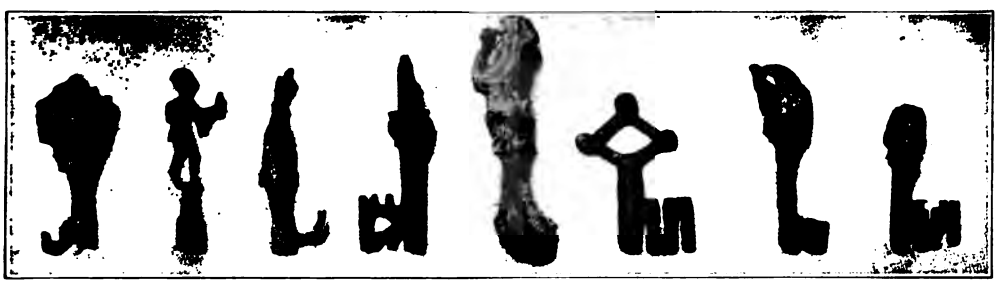
some of the same movements as the arm of a man, while for the left one is substituted a pair of combination tongs and scissors.

The interior of the device contains a small electric lamp which serves to light a considerable area under the water. The diver communicates above by means of a telephone; a special apparatus furnishes him with air, allowing him to remain under water for a long time. The suit is considered practical.

DIVING MACHINE RESEMBLES MAN.
Queer invention of an Italian mechanic to help submarine workers.

contracts for bunting of American manufacture, the national flags had been manufactured in foreign countries and from foreign wool.

In that year the late owner of the flag, while on a visit to Gen. Benjamin Butler, undertook the manufacture of bunting in America, with the result that a mill at Lowell, Mass., was placed at his disposal and his efforts were successful. He was then introduced to President Lincoln, the interview



KEYS MADE BY THE ROMANS FOR VARIOUS LOCKS.
It is curious to note in this photograph the resemblance between the ancient and modern forms of keys. Several of them might easily be mistaken for modern designs.

AMERICAN FLAG SOLD AT ENGLISH AUCTION

THERE was recently put up for auction at Covent Garden, the first American flag ever manufactured in the United States, of American made bunting, to which an interesting history attaches. It may not be generally known that until the act of Congress, passed in 1865, empowering the Secretaries of War, the Navy and the Treasury, to enter into

taking place just three days before the President was assassinated. A specimen of the material was submitted to the president, approved and ultimately resulted in the contract being obtained. The first flag made in America from American goods was from the specimen of bunting submitted to the President, every star and stripe being sewn by hand, and was sent to the late owner by Gen. Butler.

THE OLDEST GRIST MILL

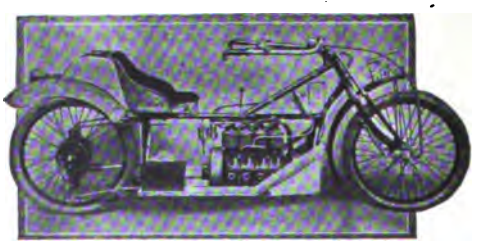
IN New London, Conn., stands the oldest grist mill in the country, a picturesque building, with waterwheel as it was originally used. New London, when it was first settled, was an agricultural community and a mill to grind the corn was a need that soon manifested itself to the settlers. A town meeting in 1650 selected six men to build the mill and gave to John Winthrop and his heirs a monopoly of grist mills for the town of "Pequett," as it was then called, as long as they maintained the mill placed in their charge.

This is one of the first monopolies recorded in New England history.

Some time after Winthrop was granted his monopoly, a complaint was made to the general court that the people were

COMPRESSED AIR CARS IN FRANCE.
This train runs on a line to Versailles and is distinctly successful.

OLDEST GRIST MILL IN AMERICA.
It was built in 1650 and still stands. It was the beginning of the first monopoly granted in this country.



NEW ENGLISH TOURING AUTO-CYCLE.

not duly served in the grinding of their corn and that body ordered James Rogers, who had sub-leased the mill from Winthrop, to give daily attendance at the mill that "no more disturbance of the peace might arise from this cause." Then Rogers and Winthrop had a long law-suit over the mill, during which the Governor's sons set up a rival bolting mill. Rogers erected another building to shut off all communication between the new mill and the highway. This brought matters to a crisis and two commissioners were appointed to settle the matter. The Winthrops settled with a money payment and had a monopoly of the business until 1709 when another firm was authorized in town meeting to build a mill.

WEEVIL INFECTED CORN.
Texas grain suffers heavily from this pest, and efforts are many to end its ravages.

with his family and household pets. Here is another way: engage as a day-laborer with the trainload of *cholos,* or Mexican knights of the pick and shovel, who have been working recently on the harbor improvements at San Pedro, California.

Then you may be given a stateroom, consisting of one-half of a box-car, for yourself and family—and, perhaps, a boarder or two! This apartment you can make homelike with furniture in the packing case style, or any other departure from the conventional Pullman car plush-and-stuffiness. Water is provided from the tank car, and although no diner, with exorbitant prices and impertinent waiters is attached, one can dine *en famille* at one's convenience. Moreover, the table may be adorned with cut flowers from one's own garden, planted in a soap box and nailed to the side of the car. There seems to be as much room for contentment here as in many a more stationary home for laborers.

HOUSEKEEPING IN A FREIGHT CAR.
Laborers at San Pedro, California, enjoy comforts of home on board cars.

TRAIN LOAD OF HOMES.
The "cholo," or knight of the pick, likes to have his family with him.

HOUSEKEEPING IN A FREIGHT TRAIN

TO see the world and at the same time enjoy all the comforts of home has been the desire of travelers since the cruise of Noah

OLD MOTOR CAR OF THE SULTAN.
This machine was built and presented to the Sultan some years ago by an English engineer.

A BALLOON CAMERA

THE Swiss captain, Spelterini, who has successfully accomplished 537 balloon trips, which up to 1904 were chiefly for the purpose of taking balloon photographs of the Alps for a scientific work, used very successfully a folding camera, taking with it some of the most beautiful and interesting pictures, which were shown for the first time in the Berlin "Urania."

BALLOON CAMERA—CLOSED.

The makers of the camera mentioned now have manufactured a special balloon camera, which is shown in the pictures, and with it the accompanying view of Lindau was taken from the *Zeppelin III*. This photograph is especially interesting, as on it the shadow of the airship can be seen at the edge of the wide shadow in the lower right hand corner. When taking a picture the camera is held over the side of the airship, or in some cases is fastened to the edge of it.

BALLOON CAMERA—OPEN.

COBLESS CORN

AMONG the many interesting novelties that have been developed in recent years, is the much talked of "Cobless Corn." The original ear was found in a field of corn grown by Mr. Taylor Gerlaugh, Sidell, Ill., and from white seed corn, purchased in Indiana. From it was produced a number of fine ears, true to type, of very large size, and thoroughly developed. The kernels of the ears are each enclosed in an individual husk, which is attached to a thin shell. This shell encloses the pith, corresponding to the pith of the cob, the same as in ordinary corn, and the entire weight of shell and pith is only about three per cent of the weight of the entire ear.

COBLESS CORN.
Development of cereal with view to protection from weevils, but probably only a return to original type. Experiments are now being carried on to test its efficiency.

The probability is that this corn is a partial reversion to the type of the primitive corn of the Indians, only in a more highly developed state. The corn centuries ago was very inferior to the corn of today as regards quality, size and yield, and these ears shown in the accompanying photo are fair specimens of what the older type of grain was like.

The most interesting feature, however, is the fact that the husk completely protects the kernel, and following this idea, an experiment has been started to test its weevil resisting efficiency.

A PEEP INTO THE FUTURE

ONE of the most curious features of mono-rail gyroscopic traffic will be the novel types of bridge over which the new cars will pass. Mr. Brennan, the inventor, has already demonstrated that a large model car can pass across a wide gulf on a single strand. This fact opens up vistas of new modes of travel, and in the drawing herewith some idea is given of how a large mono-rail car, such as the inventor has sketched out, will pass across a river-gorge. The double flanges would keep the wheels on the cable and the car would of course, keep itself erect just as easily while resting on a cable as on a single perfectly straight and rigid land rail.

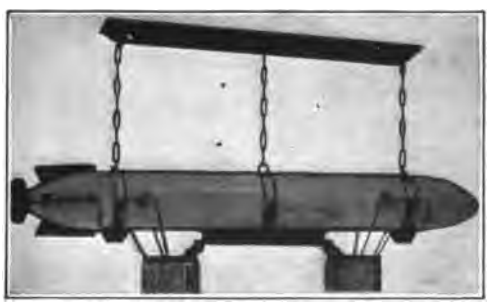
A PEEP INTO THE FUTURE.
What the monorail bridge of the coming age will probably look like.

The apparatus, costing $1,250,000, will be the great attraction of the Exposition at Brussels. It works on the principle that selenium changes its electrical resistance with the intensity of light falling on it. Screens consisting of 10,000 selenium cells will be constructed, and each cell will send out an electric current, the strength of which will depend upon the intensity of the light. These currents of different strengths will flow through the connecting wires to the sensitive mirror galvanometers of the receiving screen, thus reproducing the image.

AIRSHIP AS ROYAL CHANDELIER

RECENTLY another baby was born to the German crown prince and among the godfathers is the famous aeronaut Count Zeppelin. The count presented the baby a chandelier one yard in length, an exact reproduction of his famous *Zeppelin III*, in colored glass and prisms.

LONG DISTANCE SEER.
Apparatus, costing $1,250,000, that enables images to be transmitted instantly by wire.



CHANDELIER MODELED AFTER AIRSHIP.
Count Zeppelin's present to the baby son of the German crown prince.

ELECTRIC LONG DISTANCE SEER

THE illustration shows an invention by means of which it is possible to transmit instantly the image of anything happening at one end of an electric wire to a screen at the other end.

AN AERIAL RAILWAY

THE first aerial railway is in the course of construction. The idea is a German one, and, while very ingenious, is altogether too chimerical for practical use. The device consists of a balloon and carriages. One or more of the latter may be attached to the balloon. The balloon serves the purpose of eliminating the weight of the carriages, the regulation being accomplished by the use of water ballast. The shape of the balloon is a cylinder with cones on both ends. The carriages are fastened below the balloon; their construction is as light as possible, rounded in front and rear to minimize the air resistance. There are two divisions, one for the motorman, one for the passengers, the latter with a capacity up to sixty persons. Two carriages may be connected by an aisle. Lighting and heating is to be done by electricity. The movement is accomplished by motors, the axles of which are prolonged, carrying on their ends wheels which press against cables, one on each side. The electricity is brought to the motors from a wire with trolley contact beneath the carriages.

USEFUL FORM OF PILE-DRIVER.
This machine pivots on its carriage and is movable in all directions, greatly facilitating its work.

A company is about to construct a line according to this project from the railway station in Marburg to Frauenberg, with elevation five miles in extent and 1,200 feet above the town. The picture reproduced herewith is an artist's anticipatory drawing, representing the aerial cars actually in transit across a long river bridge on the new balloon railway line.

COMBINATION AIRSHIP AND ELEVATED ROAD.
Chimerical dream of a German engineer, to support cars by gas-bags that run between tracks.

GAUGING MAPLE-SAP FLOW

SOME sugar maple trees have a much higher sap pressure than others—these, as it is found, being the trees which have the most foliage, and which enjoy the benefit of the greatest amount of sunshine. The heat of the sun causes the sap in the leaves to expand, thus exerting a downward pressure which causes the sugary syrup to trickle out when a hole is bored in the trunk below. The pressure of sap varies at different heights in the tree, being greater below than above. It is measured by means of a new and ingenious contrivance, which consists simply of a dial, attached to the end of a tube that is thrust into the tree. A pointer on the dial shows the amount of pressure, which, as observation has proved, is much stronger in the forenoon than later in the day.

The sap enters the tube, which is driven in like the usual tap, and presses against a gauge that influences the needle in its position on the dial.

GAUGING THE FLOW OF SAP.
Pressure from the tree's veins is now accurately registered.

MARKING THE TAXICAB'S DISTANCE.
Plates used on course over which vehicles are being tested for the purpose of preventing overcharges.

STANDARDIZING TAXICABS

WHILE every other branch of public service has been standardized by the weights and measures departments of the various cities, up to this time no city has actually made any move to measure and standardize the taximeters of taxicabs except the city of Boston. That city has put into operation the actual testing of taxicabs in its streets and, upon the success of the tests in Boston, the adoption of the scheme by New York hangs at the present time. The weights and measures department has had bronze plates made to be set in the curbing at intervals from one-quarter to one even mile. Several sets of these plates have been cemented into place along many streets of the city and the cabs are being driven over the course. An observer of the department records any deviations in the registers. He also tests the clocks which indicate the waiting time, seals the taximeter and gives a certificate if the machine comes up to the standard.

FRENCH LOCOMOTIVE.
Type of engine much used in France for passenger trains.

LOCOMOTIVE IN IRELAND.
Odd looking form of engine that does heavy work in the Emerald Isle.

INTERESTING CONTRAST IN LOCOMOTIVES

REPRODUCED on this page are five photographs of locomotives curiously differing, but all in regular and useful service in railroad work. In each country where the railroads are extensive and powerful, many types of engines are found in different branches of work and for varying purposes; but each country seems to prefer a distinct general pattern, that, to the expert, is readily recognizable. It is almost as if the locomotives differed with differences of racial characteristics or national individuality. It is quite certain that geographical and climatic conditions materially influence the designs. For instance, the open-cab English engine would never obtain on our plains where the blizzard must be negotiated.

ONE OF AMERICA'S BIG ONES.
Twelve-wheeler that hauls a half mile of freight cars.

AN ENGLISH FLYER.
One of the fast train-pullers of Britain that competes for speed honors with America's best record makers.

A MOUNTAIN CLIMBER.
Locomotive used on Mt. Tamalpias, in California, eight-cylinder form, differing essentially from kind used on the levels.

A MOTOR SNOW-PLOW

IMMENSE masses of snow fell everywhere this winter over central Europe, and Germany received probably the largest share. The municipalities had unusual difficulties to remove these masses and many thousands of workmen, teams, carts and snowplows were employed. In Berlin the daily expense was 60,000 marks and yet it took over a week to clear the public streets from the snow. Here for the first time the motor car was pressed into service and this with fine result. A large automobile firm placed one of their six-ton trucks of thirty-two horse power at the disposal of the city. Its front was fastened to a wooden plow of triangular shape and this was driven through the huge snowpiles, pushing the snow to both sides and making a fine path for driving. The great advantage besides the strong power is that the driving wheels are always on that portion of the road already cleaned while horses must wade through the deep snow before it is removed.

WHEN IS A MOTOR-BOAT NOT A MOTOR-BOAT?
When its propeller is lifted out of water by a turn of the hand, as this one has been lifted. An interesting application of small power.

MOTOR SNOW-PLOW A SUCCESS.
Berlin has applied the automobile to the clearing of her streets.

WIND-PRESSURE INDICATOR.
Pressure of the breeze against the flat plate at the left operates the indicator on the principle of a weighing scale.

RECENT ERUPTION OF MOUNT TENERIFFE.
View shows the wide scattering of ash and debris that causes havoc in volcanic eruption. Mt. Teneriffe is in the Canary Islands.

WHEN TO FLY

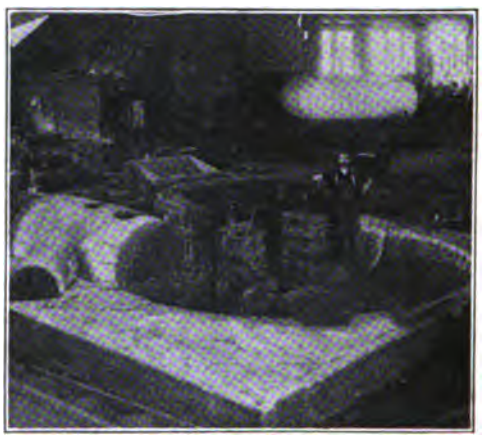
AVIATORS will be interested to hear that a London firm have just produced an apparatus designed to indicate the velocity of the wind without any figuring or formulae, and which shows at a glance when it is possible for man to fly. The apparatus is based on an invention of Sir Hiram Maxim, and a particular feature of it is the patented system of levers, which makes it possible to have the spaces on the dial practically equidistant one from the other. If the pressure acted on the spring direct, the spaces indicating the low velocities would have to be very close together, while those indicating high velocities would have to be widely separated. The index, being fairly large, can be read at a considerable distance, while it acts as a tail and keeps the apparatus face to the wind.

The principle on which the machine acts is almost identical with that of the weighing scale which operates by means of an adjustable spring. The pressure of the wind comes against the end plate, influences the indicator.

HIGH PRESSURE WATER-TURBINE.
Machine that generates 13,000 horse power for Duluth Company, and is a remarkable engine of its type.

BIG WATER ENGINE

A HIGH pressure water-turbine having a capacity of 13,000 horse power is shown in the accompanying illustrations as constructed for a company of Duluth, Minn. This enormous turbine operates at a head of 380 feet, working at a speed of 375 revolutions per minute. One of these great cast steel "snail cases" weighs 83,530 pounds, its huge dimensions being indicated by the comparison of the height of the workmen in the illustration. The enormous mould required for the casting of this great forty-ton piece is noted in the other illustration. In the background of this photograph will be seen the immense core just being removed from the oven before being placed in position in the mould.



MOULD FOR MAKING BIG TURBINE.
So-called "snail-case," weighing 83,530 pounds, was cast in this form for the turbine shown above.

LIGHTING THE INSIDE OF MAN

SINCE the day when the eye mirror was invented by Helmholtz, it has become possible to examine the conditions of the eyes of patients and to ascertain any morbid alteration of them. In using this ingenious device, however, the light is thrown through the pupils and upon the background, and is reflected from the latter so as to reach the observer's eye. This method, thus, is specially adapted to show any color shades in the background. Now, it occurred to Dr. Carl Hertzell, of Berlin, that in many cases it would be preferable to illuminate the eye from within by placing an electric lamp in the mouth of the patient, thus lighting the retina from the back. The background of the eye is thus placed between the lamp and the observer, and while differences in color do not appear so strikingly as in connection with the eye miror, most pathological alterations are recognized with even more distinctness, owing to the attendant differences in transparencies. The lamp is cooled by a continuous stream of water flowing within it.

The photograph shows a patient under examination masked to prevent confusing light reflections from interfering with the oculist's study of the eyes.

LAMP IN THE MOUTH LIGHTS THE EYES.
New method of studying diseases of the optic organs by novel kind of illumination within the mouth and throat.

NEW YORK'S NEW BRIDGE

THE new Manhattan bridge across East River, New York, is the third largest suspension bridge in the world. So far as passenger capacity is concerned the new bridge will be the most important spanning the East River. Eight tracks will be laid across it and the cars and trains will be able to handle 1,000 persons a minute. The roadway for vehicles is between the railroad tracks and is forty feet wide. There are two footpaths, each twelve feet wide, on the outer edge of the bridge.

The first caisson was sunk in 1902, but work was then suspended because of a change in the design. In March of last year the first girder was put in place and a few weeks later the lower deck of the bridge was joined in the middle of the river. The entire structure has been built in a little over five years. The span from tower center to tower center measures 1,470 feet. The Williamsburg span is longer, 1,800 feet, and the Brooklyn Bridge five feet less.

MANHATTAN BRIDGE RECENTLY OPENED.
New York's latest structure across East River.

PULPIT BUILT OUTSIDE CHURCH.
Grace Church, in New York, provides services outside its doors.

NEW BABY MUSK-OX

A NEW baby musk-ox, one of the rarest and most noteworthy animals of the Polar world and one seldom seen in the temperate zone, has recently arrived and is on exhibition at the New York Zoological Garden. The present one is said to be the only specimen in captivity in the United States. The little northern dwelling creature has come from over a six thousand miles journey from Melville Island, one of the most westerly of the Arctic Islands. She was captured by Capt. Joseph E. Bernier, an Explorer of the Canadian Government, and brought on a vessel to Quebec.

AN OPEN AIR PULPIT

GRACE CHURCH, on Broadway, New York, known to every town in the United States because of the famous Broadway Scene in "The Old Homestead," is to have an open air pulpit. The photograph shows the unique pulpit that is being built on the new addition to the famous church. Demolishing the corner property, also famous as the scene of the nightly gathering of hungry men applying for stale bread at the bakery that stood here, the church has added a handsome new wing, with courtyard. The new pulpit will look upon this courtyard and services will be held here.

EXPLOSION WRECKS FACTORY.
Tremendous effect of the bursting of a shoe-factory's boiler.

DISTILLING EUCALYPTUS OIL.
Making extract that is used as a remedy for catarrhal troubles.

COSTLY EXPLOSION

THE accompanying photograph is one of a boiler which exploded at Aylmer, Ont., recently. A spectator is standing on two-thirds of the boiler split open. The front portion of the steel was blown over 400 feet away from the pump house, which is seen to be mostly demolished. The engineer of the plant was killed by the explosion and the shoe-factory, of which it was part, was practically demolished. It was a very costly explosion, indeed, the cause of which is not definitely known. The destructive effect was so complete as to be simply amazing.

QUEER KIND OF DISTILLERY

THIS curious-looking still is located in the neighborhood of Los Angeles, Cal., and is used for rather an out-of-the-way purpose—that is to say, for distilling eucalyptus oil. The oil in question has a good many medicinal uses, being an excellent disinfectant, and especially good for catarrhal troubles. It is employed as an ingredient in many remedies for affections of the throat and nasal passages.

SILOS OF CONCRETE BLOCKS

THESE silos, which were constructed for a cheese company, at Winslow, Ill., are of concrete construction throughout. The floors and foundations are of monolithic concrete, the walls and chutes of concrete blocks and the roof of reinforced concrete. They are forty-eight feet in height and twenty-two feet in diameter.

CONCRETE BLOCK SILO.
An interesting construction of substantial form that promises to last.

TO CONSERVE EGGS

TRIALS recently made for the conservation of eggs resulted in the recommendation of a five per cent solution of hydrosuperoxyd. Eggs immersed in this solution during seven summer months at room temperature were void of any disagreeable smell and taste. The white and the yolk were in exactly the same state as in fresh eggs. In boiling such eggs the white was found to be a little harder, but not changed otherwise.

CHAIN GROWN INTO TREE

A CURIOUS discovery was made recently at Winthrop, Mass., when a tree fifty years old was cut down and split up. The tree had long been used as a hitching-post for horses, from the time when it was a stout sapling. The man who cut it down thought that a staple had been driven into the trunk, as he saw a link protruding, but when he split it open he found that the staple was one link of a long hitching chain and the tree had grown about it in some way, so that the links were imbedded in the trunk for almost its entire diameter.

TREE HIDES CHAIN WITHIN ITSELF.
Remarkable growth found at Winthrop, Mass.

A NEW FRENCH CAR

THERE has recently been introduced and is now being tested in Paris a new style of hansom-cab, with the driver's seat elevated behind. It has a number of points in its favor, among which is that of the unobstructed view which it affords the passengers. This construction is criticized and may develop mechanical disadvantages, but these can be easily overcome.

The fact that the cabs are running successfully and are being patronized generously, goes far to prove efficiency. The lines of the machine are quite as pleasing as ever were those of the horse-vehicle to which it corresponds, and its advantages are the same as those that recommended it to use. It is a more convenient conveyance, too, being lower, opening at the side and being much more commodious for passengers.

OLDEST PIANO IN AMERICA

CHARLES W. GRAY of Portsmouth, N. H., is the proud owner of what he believes to be the oldest pianoforte in this country. It was built in London by Johann Zumpe in 1763, and was brought to the United States in 1784 for John Jacob Astor. During the passage across the ocean it was with difficulty that the strings were kept from rusting, and after its arrival in New York the much drier atmosphere caused the wood work to crack. The piano remained in the Astor family until early in 1800, when it went into the possession of others. The tone of the piano resembles that of a guitar.

NEW FRENCH MOTOR-CAB.
A comfortable and useful vehicle that combines good features of hansom and four-wheeler.

OLDEST PIANO IN AMERICA.
This instrument is said to antedate any other of its kind in this country. It was built in 1763.

POWER OF A FLY

A COMMON house fly can be said to possess almost superhuman power which is attributed to the fact that the fly, unlike man, has an extensive net of breathing organs which enables it to burn more nourishment, thus creating a greater working energy. The relation of the food consumed to the labor performed was determined in this way. The fly, tied or glued to a cork, was fed regularly from a needle dipped in honey, and the needle weighed before and after each feeding. The fly was then placed in a narrow box on the edge of a wheel and forced to run around the edge, as in a treadmill. As the weight of the wheel was known, and the number of its revolutions counted, it was easy to determine the amount of labor performed. Another experiment was made as follows: A fly was tied down on its back, and then made to balance a comparatively heavy pith ball, on which was another fly. When considering that it is an acrobatic feat for a man to balance another on extended arms and legs, that is to say, balance his own weight for a length of time, we must admire the feat of the fly, that, without apparent fatigue, balanced the ball and fly for several hours.

FLY SUPPORTS FLY ON PITH-BALL.

FEEDING FLY FROM NEEDLE DIPPED IN HONEY.

TESTING FLY'S ENDURANCE ON A WHEEL.

NOVEL MOTOR BOAT CATAMARAN OF TWO FLOATS FILLED WITH COMPRESSED AIR.

A NOVEL MOTOR BOAT

THE catamaran type has been a favorite with certain boatmen in America which has been by no means behind hand in this direction. A boat on this principle has been built by Mr. Wm. J. Reed, Janesville, Wisconsin, consisting of two floats eleven inches in diameter and thirty feet long. After a number of experiments, the results have been so encouraging that a new boat is to be built with sixteen inch tubes and a larger engine. The propeller is placed where it does not take water from under the tubes, and the boat runs on an even keel. The rudder is placed forward, as it has been found not to stop the boat's way nearly so much as when placed aft of the propeller. A small air pump, driven by the engine, keeps a certain pressure always in the floats. For smooth, sheltered waters, this type of boat seems likely to become very popular.

SUSPENDED BRIDGE SUPPORTS A WORK-TRAIN. Ingenious device for carrying dump-cars out over space to be filled.

DANGEROUS BEAUTIES

PASSENGERS on the transatlantic lines whose route goes near the Banks of Newfoundland, frequently observe enormous and beautiful ice-bergs. There is so much danger connected with these ice-islands, as they might be called, that it is not altogether a pleasure to sight them, especially if a fog hides them until they are near at hand. As ice is only a little lighter than water, about seven-eighths of the whole mass is under the surface. The danger is obvious.

PRETTY, BUT DANGEROUS. As seven-eighths of an ice-berg is always hidden under water, its dangerous character is obvious.

ELECTRIC HURRY-UP WAGON

A NEW and very convenient method of application of trackless electric vehicles for electric railway service is developed in the form of a hurry-up or electric tower wagon. This hurry-up wagon has a speed of twelve miles per hour, and a range of forty miles on one charge of the battery. The whole design of the equipment is so well illustrated that description is hardly necessary. The wagon has sufficient space for seven men in addition to the driver, also space for tools and material for repairs. One of the important advantages of the electric hurry-up wagon is its immediate readiness for service; where adopted it is not necessary for electric railway companies to maintain a team of horses constantly harnessed ready for emergency service.

AUTO REPAIR WAGON.
Latest addition to the "hurry-up" service.

REGISTERS LETTERS AUTOMATICALLY.
French machine makes registration of letters by number so as to insure delivery and identification.

LOCOMOTIVE PILE-DRIVER.
New device for railroad work that folds its uprights when not in service.

A LOCOMOTIVE PILE DRIVER

A NEW development in mechanical engineering is a locomotive pile-driver in which there is an unusual arrangement and strength of the self-propelling mechanism, and in the self-contained hydraulic turntable, whereby the entire machine, including trucks, is quickly lifted clear of the rails and turned end for end. The engines, on the car, are connected to the axles of ordinary trucks without interfering with the movements of the trucks in turning curves, passing over frogs, and the like.

The machine was designed to meet the requirement for a pile driver capable of climbing any grade and hauling its own cars of piles and tools. The self-propelling pile drivers built hitherto are capable of moving themselves for short distances only.

GYROSCOPE TO BALANCE AEROPLANE

ONE of the most difficult problems set to aviators is to invent a mechanical balance which will steady aeroplanes in flight. Capt. Maitland has mounted a two horse-power gyroscope on a Voisin biplane, capable of making 3,000 revolutions per minute, and having a stabilizing force of 300 pounds. The experiment is being watched with great interest. In our photograph one of the Gyroscopes is seen to the right of Capt. Maitland. The biplane fitted with this is called the "Moreing."

GYROSCOPE INSTALLED ON AEROPLANE.
Device may be seen near right shoulder of the aeronaut.

COMPRESSED AIR PLANT ON WHEELS.
Electric pump that can be wheeled to any part of a plant where compressed air is needed.

INTERURBAN CONDUCTOR REPORTING.
New telephone system for easy communication with dispatcher, that is being installed on electric lines.

TEST OF AN ELECTRIC AUTO.
One manufacturer resorts to an odd method to demonstrate efficiency of his machine.

"WALKING MEN"—AN ENGINEERING NOVELTY.
The gangways consist of two frames, each of which may be raised and pushed forward, resting on the other. Thus the device "walks" along new construction work.

ABOUT BASALT

BASALT may be considered as the classic witness of former volcanic activity. Wherever it is found, Nature was at one time in a tremendous uproar, the earth trembling and hurling smoldering vapors mixed with masses of stones up into the clouds, while searing flashes ignited the fertile land.

What we call Basalt, used to be Lava which did not penetrate to the surface, but remained under the enormous pressure of the upper masses. The formation of pillars is the result of the combined pressure and shrinkage caused by slow cooling. The dimensions of the pillars are different, and vary from the thickness of a finger to one yard.

The typical land of Basalt is Iceland, while one of the most magnificent deposits is at Linz, Prussia, which is shown on our picture.

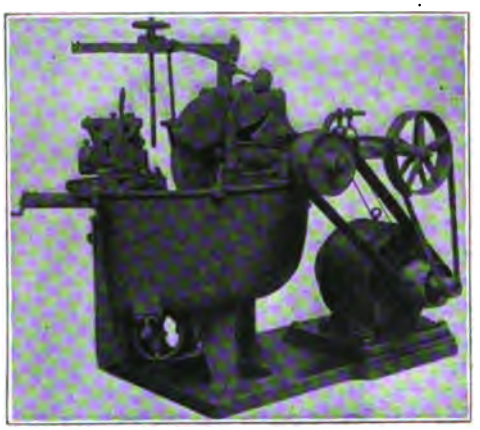
BASALT FORMATION AT LINZ ON THE RHINE.
Remarkable deposit of lava that has split into pillars because of pressure.

MOTOR WHEEL FOR BICYCLES.
New attachment for ordinary wheel that transforms it into a motor cycle.

A TOURING AUTO-CYCLE

THERE is a growing demand now-a-days for a motor cycle constructed as far as is possible on car lines, and which can be started and driven in a manner resembling that employed with the more expensive and heavier vehicles. One or two well-known firms are laying themselves out to cater, in 1910, specially for these demands. One concern is making a motor wheel, designed as an attachment to transform an ordinary bicycle into a motor-cycle.

SEE THE AIR-SHIP'S SHADOW?
In the center at the bottom of the picture is the shadow of the end of the *Zeppelin III.* from which this photograph was taken.



MOTOR DRIVEN TOOL-GRINDER.
Valuable piece of machinery for shop use that shows how compactly such installations are being made.

MAGNETIZED CAR-WHEELS MAKE DIFFICULT CLIMB.
Wheels, composed of four segments, each a magnet, enable car to do remarkable things.

CRYSTALLINE GRAPHITE ORE.
Section much magnified, showing how the flakes of graphite lie in ore that produces 6.25% pure graphite.

FOUR GREAT ENGLISH BLAST FURNACES

THE blast furnaces shown herewith are each sixty-one and a half feet high and are outwardly huge cylinders of iron plates. These conceal the firebrick lining within them. At the top can be seen the gallery from which the charges are fed into the mouth of the furnace, which is no longer open as in the old days when the gases flared off to waste. Alongside the furnaces are also seen the domed-top stoves in which the air used for the blast in the furnaces is heated. The method employed is much like American methods already described in TECHNICAL WORLD MAGAZINE. The procedure followed in tapping a blast furnace is interesting. The iron is drawn off at the bottom of the furnace and then flows along channels which have been moulded in a large bed of sand. The iron is allowed to flow down the moulds much in the same way as a field is irrigated. The picture at the bottom of the page illustrates the process. At these iron works castings are produced varying in size from quite small objects up to pillars thirty-two feet in length and weighing forty tons. Great quantities of ranges, grates, stoves, baths, and large sugar cauldrons for the West Indies, and hundreds of articles of everyday use, are cast. Enameling and all the various finishing processes are also carried out there. The pictures suggest that America has not an entire monopoly of the iron industry as she is apt to think she has.

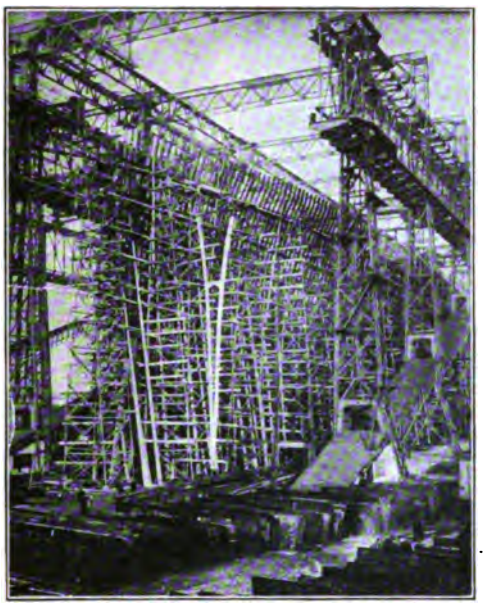
TWO SLIPS READY FOR BUILDING LINERS.
View in English ship-yard, where giant steamers are building. See opposite page.

FOUR HUGE ENGLISH BLAST FURNACES.
Where British ore is reduced and manufactured into iron.

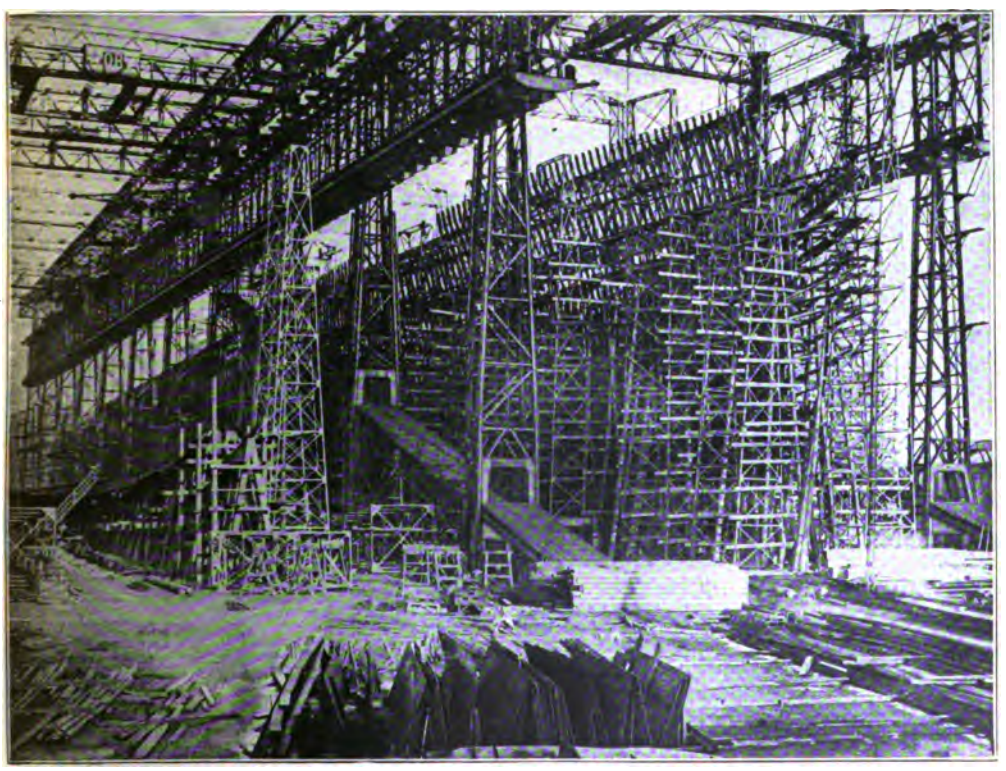
TAPPING THE FURNACES.
Molten iron flows out into the trenches in sand, like water irrigating a garden-patch.

NEW OCEAN LINERS ON STOCKS

THE two views on this page and one at top of the opposite page, show the two new giant White Star liners under construction. The three views were taken for the firm which is building these giant vessels. The keel-plate of the *Olympic* was laid considerably earlier than that of her sister vessel; indeed, a beginning was made on December 15, 1908, before the special staging shown here was completed. The framing of the *Olympic* took just eleven months and five days. Concurrently with the framing a large amount of other work has been carried forward. The entire bottom and water ballast tanks were hydraulically riveted, and contain over half a million rivets. The plating of the sides is now well started, and good headway has been made with the decks and stringers. The framework looks like a forest in steel.



BEGINNINGS OF A GIANT OCEAN LINER.
Frames of new White Star ship, *Olympic*, in place in English ship-yard.



STEEL STAGING FOR BUILDING TWO GREAT SHIPS.
Preparations for construction, in themselves, look like a huge building.

VALUABLE FURS.
Four silver fox skins that are worth together $1,500. Some extra fine skins have brought more than this apiece.

ONE CONTROL FOR MANY WINDOWS.
Twenty-eight frames all moved by one device. Useful for big windows.

SKINS WORTH MUCH MONEY

THE silver fox is a very rare animal. He never was exceedingly plentiful and as his pelt has become a favorite, partly because of its excellent quality and partly because of rarity, he is growing rarer still. The skin is a beautiful one. Those pictured on this page are not by any means the finest obtained. The price received for them at a recent sale was about $1,500 for the four. Some single skins have brought as high as $2,500.

BICYCLE SHOWS FAT IN MILK

A RECENT German patent has been issued for a very interesting instrument for determining the percentage of fat in milk. Although this test was formerly a rather expensive one, it is now attended by practically no financial outlay because a bicycle is used for this new method. The filled "Butyrometers" are put into tubes and fastened to the rear wheel, and by turning the pedals the fat is thrown out. The bicycle is either turned and rested on the saddle, or hung up, or still better, placed on its side on a tub or barrel in a way that will allow the pedals to move freely. A wheel with coaster brake is best, allowing one to rest at times while the wheel revolves by itself. After three minutes of vigorous turning, the test is finished, and as soon as the wheels are stationary, the "Butyrometers" are carefully taken out, and the fat percentage is read in the usual way.

MILK-TESTERS ATTACHED TO BICYCLE WHEEL.

THE "BIKE" AS A MILK-TESTING MACHINE.
The testers attached to a bicycle wheel separate the fat from the milk on rapid rotation.

NEW TYPE OF SUBMARINE

THE new English Submarine marks an entirely new departure in these weapons of war. They are nearly double the size of the former types, and are propelled by twin screws. The great feature is the increased speed which the twin screws give and the greater manoeuvering power, both upon the surface and submerged, while the radius of action is considerably in excess of the older classes. On the surface the vessel looks surprisingly long, and her increased size gives her much more deck accommodation. She has but one conning tower but is provided with one periscope forward and another aft.

In the struggle for supremacy on the seas, most popular attention centers on the dreadnaughts. But other types of fighting ships are also being built.

NEW ENGLISH SUBMARINE.
Nearly double size of other types, it has much higher speed.

THE BOY AVIATOR

CROMWELL DIXON, boy aviator, just seventeen years old, just made more than 275 successful flights in his home-made dirigible airship. Cromwell, as everyone calls him wherever he goes with his airship, has been flying the dirigible ever since he was thirteen years old and has supported his widowed mother and his sister on the proceeds derived from his trips to the clouds. Cromwell has talked airships, studied airships and dreamed about this kind of an airship ever since he has been able to read, and his mother, his guiding help in his work, says he tried to build an airship when he was ten years old. Three years later he made his first flight in Columbus.

In the TECHNICAL WORLD MAGAZINE for December, 1907, appeared an article about this boy's early work with a dirigible propelled by foot-power, like a bicycle. That was only the beginning for young Dixon.

FIELD FOR ORCHARD HEATERS.
Western orchard in bloom. Heaters can be distinguished on the ground, ready for frost.

BOY AVIATOR GETTING FAMOUS.
Cromwell Dixon, who commenced flying when thirteen years old.

THE BUILT-UP PROPELLER

THE new aeroplane propeller, as used by Henry Farman, Louis Paulhan and Louis Bleriot, and which will be fitted to the big Bayard-Clement airship now under construction, is of the wooden built-up type, the various portions being bolted together at the hub and formed into one solid block by the use of a special glue. It might be supposed that a propeller cut out of a solid piece would be more satisfactory than one built up of several layers, but it has the disadvantage of producing a propeller that cannot be perfectly balanced. A block of wood has not the same density throughout, the difference in density being much greater in the wood obtained from near the base of the tree than near the top of the trunk. Thus, when a propeller is carved out of the block, the resistance varies with the density of the wood, and a perfect balance becomes very difficult, if not impossible. The wood used in the construction of this built-up propeller is the finest quality of ash, without flaws and thoroughly well seasoned. It is cut into long blades of varying thickness, each blade conforming roughly to the plane section of the finished propeller. By cutting the wood into planks it is impossible for a defective piece to pass unobserved, whereas, if carved out of the mass it is possible for the outside to appear perfect, while the interior of the block may contain flaws.

BUILDING AN AEROPLANE PROPELLER.
The best air-screws are made from a number of planks glued together and shaped to form.

FINISHING AEROPLANE PROPELLER.
When completed and dressed down to a fine finish it is stronger and better balanced than if made from one piece.

BIG SEAL IS A PET.
Huge animal at Pacific coast resort is tame and playful as a kitten.

A QUEER MARINE PET

ALL visitors to Santa Catalina Island make the acquaintance of Ben, the big seal, who is constantly seen in the waters of the harbor swimming on the surface or under the water in the shallows. This huge animal is as playful as a kitten and just about as tame, although he is not in any sense a captive as he has the whole Pacific Ocean to range in. Ben is always on the lookout for a fish dinner and when a visitor attracts his attention by throwing a big stone into the water he will come barking with delight and dive for it. As he takes his disappointments philosophically, he is usually rewarded with a real fish, as shown in the picture.

RAILWAY TRACK TRAVELS

AN interesting phenomenon of railway operation is that of "creeping" of rails. One of the most remarkable instances of this kind is found on the Delaware & Hudson River Railroad between Sand Hill and Vernon, N. J. The road runs here over three miles of wet, spongy meadows, which evidently were formerly the bed of a lake. Before 1904, 65-pound rails were used, and were laid on pole and square ties which were 8 feet 6 inches long, except for 1,500 feet of the weakest portion of the track, where they were ten feet long. When a train passed the whole track sank under it. The effect was as if the train were going up grade, and this caused it to push not only the rails but the entire track before it. About sixty per cent of the traffic was eastward; consequently the predominant movement of the track was eastward. It crept as much as thirteen feet in a single week.

By means of heavier rails and longer ties, the movement of the track has been almost stopped.

A striking evidence of the amount of the undulations of the ground under passing trains was afforded while the new rails were lying for about 90 days beside the track ready to be laid. All these loose rails, which weigh 1,000 pounds apiece, moved along *opposite* to the direction of the heavier traffic, one of them going seventy feet and leaving a distinct trail behind it through the gravel, as shown in one of the illustrations.

SEASIDE BLUFF TERRACED.
Attractive home made on a rugged cliff.

CREEPING RAILROAD TRACK.
The photograph shows long ties used to stop the crawling of the rails.

CREEPING RAILROAD TRACK.
Note the path in the gravel left by rail that has crept seventy feet along the embankment.

TERRACING A SEASIDE CLIFF

ONE of the California mining kings who suddenly "struck it rich" has shown what money can do in transforming a rugged, unpromising cliff into a beautiful terraced garden. A grand staircase of concrete leads directly from the door to the beach, a long, smooth stretch inviting the surf bathers. The retaining walls are of concrete. The mass of white, which looks like snow in the picture, is in reality a solid bed of "amethyst sea moss."

SURFACE IRON MINES OF MINNESOTA.
Where the metal is taken out without any underground work. See picture at bottom of this page.

MINES ON THE SURFACE

THE most wonderful iron mines in the world are those at Hibbing and Coleraine, Minnesota. Here are the only open-mouthed iron mines on the globe. The iron ore is so close to the surface that all the Great Northern Railroad had to do was to lay tracks and back in and haul out whatever ore it pleased. It is literally a case of "merely backing up your cart" and dragging off all the wealth you can carry!

It is unusual to find metals or other valuables of Nature close to the surface. The diamond and ruby mines furnish some of the exceptions. The commoner minerals are often buried deepest.

ARMFUL OF GOLD BULLION WORTH $3,000, IN ONE PIECE.
The coins in front are ten dollar pieces—twenty-five of them.

AN ARMFUL OF GOLD

WHILE this is a good armful for a man to lift it would be worth nearly $3,000 to him because it is a bar of gold bullion such as is used in making gold coins. It is what the miner calls an ingot of gold from the Alaska mines after the refuse has been smelted by heat from the pure metal. An idea of the value of this gold can be given by noticing the eagles or ten dollar pieces piled in front. There is enough of the precious metal in it to coin no less than 300 of these eagles.

In the pile of coins are twenty-five ten dollar pieces, and it is worth therefore one-twelfth the bullion's value.

"BACK UP YOUR CART" AND FILL WITH A FORTUNE.
The only open iron mines in the world. Another view of Minnesota mines shown at top of this page where the metal is taken out practically on the surface.

A PRIVATE RAILWAY IN BUILDING.
Englishman builds road from his broad estates to his market.

FARMER'S PRIVATE RAILWAY

A LIGHT railway ten miles in length is being constructed by Alderman Arthur H. Worth, of Holbeach, Hurn, England, in order to get the produce from his farms to the nearest railroad station at Fleet. Mr. Worth is his own engineer and is carrying through the enterprise single-handed. He had noticed how useful such railroads were for works and factories, and bought plots of land until he had a clear road to the station, under his control. The line, which will cost nearly $50,000, will leave no field on Mr. Worth's farms untapped and will haul all his produce to shipping-points.

CURIOUS SUSPENSION BRIDGE.
Hung from top of cliff to deck of a wrecked battle-ship.

CURIOUS SUSPENSION BRIDGE

ON May 30th, 1906, in a dense fog, the fine first-class 14,000 tons English battleship *Montagu,* built so recently as 1903, at a cost of over $5,000,000, went ashore on the southwest corner of Lundy Island, in the British Channel.

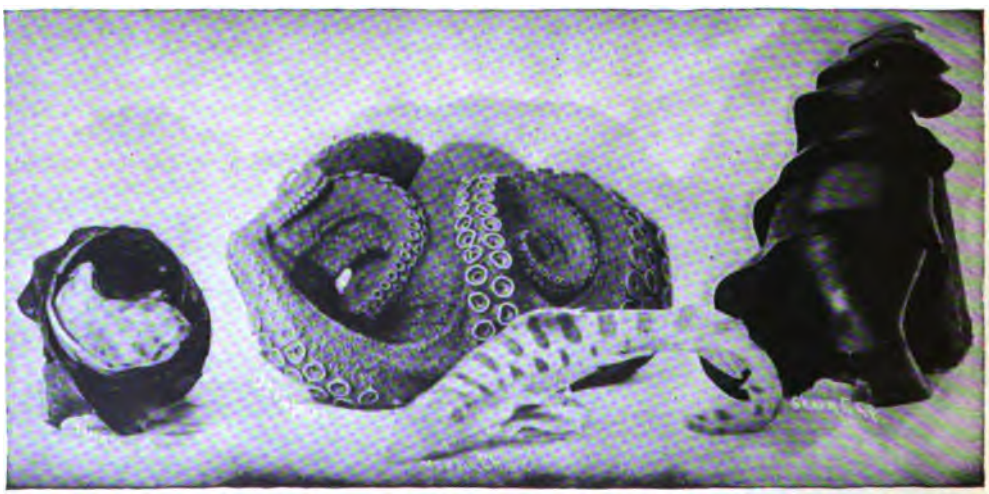
In salving the first work of the engineers was to lay an aerial footway from the top of Lundy's cliffs to the wreck. The bridge, shown in the photograph, is between 300 and 400 yards long; it is of wood, laid on four five and one-half inch steel cables. The weight of the whole construction is less than 20 tons. It gave quick and safe access to the vessel.

SINGLE COTTON MILL, AT CHICOPEE, MASSACHUSETTS.
Said to be the largest in the world. It takes an inspector an hour and a half to make one round through its rooms without stopping.

VALUABLE ZEBU CATTLE IMPORTED INTO AMERICA.
Claimed to have better beef qualities than native breeds and to be immune from cattle fever.

RAISING ZEBU CATTLE IN TEXAS

THE introduction of the Zebu or humped cattle upon the ranches of the Gulf coast region of Texas has proved highly successful. This breed of animals is commonly known as the sacred cattle of India. The original herd of this Brahma stock was brought to Texas from India in 1906 by A. P. Borden and placed upon a ranch near Pierce, where they thrived splendidly. Mr. Borden spent some time in India carefully selecting the thirty animals which comprised the original herd. Soon after their arrival in Texas fifteen of the animals were placed upon the ranch of Thomas M. O'Connor near Victoria. The offspring of the two herds now number more than twenty-four hundred head. They are scattered over many of the ranches of the southern portion of Texas. It is claimed that these Zebu cattle and the animals of mixed breed produce beef far superior to the ordinary breeds.



THREE STAGES OF THE SHARK.
This photograph shows the shark egg, with its curious spiral formation, at the right; a second egg, opened to show the young shark within, at the left; and, finally, the baby shark just hatched, in the center in front. The octopus in the background was merely thrown in for good measure.

APRIL
1910

"COMPARED WITH THESE PINNACLES ST. PAUL'S OR NOTRE DAME SEEMS INSIGNIFICANT."
Looking south on Broadway, which is bordered with the world's highest buildings.
—Park for Biggest Skyscraper, p. 174.

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HALF A CONTINENT UNDER CANVAS

By HENRY M. HYDE

"YOU are invited to attend the greatest show in the world," read the card. "The stupendous spectacle of an empire in the making. Positively the Last Appearance on the Planet of the Anglo-Saxon Pioneer! The performance will last three weeks. Come one! Come all!"

Before accepting an invitation so continental in its scope, the wise spectator will wish to make at least the casual acquaintance of the man who gives it. Thirty years ago, the Master Showman, then a tall, gaunt, young mining prospector, was accustomed to climb, hand over hand, up the steep, icy face of Silver Mountain in the Canadian Rockies, with the bosom of his blue flannel shirt stuffed with thawing sticks of dynamite. Today, though he rides through the deep, dim mountain canyons in a private car, there is still an ominous, explosive suggestion in the flashing of his black eyes when anything goes wrong about the only greatest show—be it one of the trained avalanches which has jumped the beaten track or a snow-storm scheduled to fall on the bald top of Mt. Sir Donald, during the afternoon performance, which has failed to keep its appointment.

The whole vast wilderness of the Canadian West was the play-ground and battle-field of his adventurous youth. Today he takes goggle-eyed tender-feet to view its marvels, secure in the knowledge that no corner of the white man's world offers thrills so new and keen or contrasts so astounding.

Thirty years ago the Master Showman and his fellows—every man a potential millionaire—were traveling on snow-shoes through the passes of the Rocky Mountains in far western Alberta. Half way down a deep draw they saw a column of smoke rising high into the air. Indians! They separated and each man keeping a thick fir-tree in front of him, crept down to reconnoitre. Presently the smoke turned to steam, rising from a three-foot hole in the granite. The hole gave entrance to a great empty dome-shaped cavern, at the bottom of which bubbled two feet of hot and sulphurous water. They had discovered a geyser—a tired, old geyser, easy to tame and to keep in captivity.

Cutting a tall fir tree, they trimmed its branches close to the trunk and thrust this thirty foot ladder down into the geyser's throat. Undressing in the snow, they climbed down, one after the other, to take a Turkish bath, finishing off, ten minutes later, with a cold plunge in the vast snow drift which filled most of the draw.

Today, this worn-out geyser, with a gangling Highland Scot for its attendant, occupies a tiny corner of the smallest side-show tent, along with the largest herd of bison in the world and a couple of agile rivers that do a perpetual plunge over twin precipices, to fall into each other's arms in the valley at the bottom.

But to do justice to the Master Show-

PHOTOS COPYRIGHT BY H. W. GLEASON, BOSTON

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man and his astounding aggregation of scenic marvels and continental curiosities, one must take a seat in his private car at Chicago—along with the Poet, the Dyspeptic and the Pessimist—and wait patiently while the train runs diagonally across Wisconsin to St. Paul and thence, over a long northward slant, through the lake country of Minnesota and on into the flat lands of Dakota, broken in the distance by grim, forbidding buttes.

For more than a day a cold drizzle of rain fell. All through the thickly wooded country the branches of the oaks and hickories drooped and dripped despondently. Out on the plains the frequent farmsteads, each behind its wind-break of tall, gaunt poplars, looked damp and gray under the low-hanging sky. The Master Showman lay back in his big leather chair, wrapped in silence and the smoke of shag tobacco. The preliminary stage setting was just to his liking.

Next morning the train slipped over the imaginary line which marks the international boundary and stopped at the raw little town of Portal—main entrance to the continental circus tent. The wet blanket of clouds had been taken off the sky. Overhead was unbroken blue space, flooded with brilliant sunshine. For a day the train ran swiftly across the endless plains and prairies of midwest Canada. One looked out on either side over a flat infinity, against which a raspberry bush would have loomed gigantic. There was no horizon. Until the sight failed the earth stretched away level and smooth under the high sky. At distant intervals one caught flying glimpses of white prairie schooners, tents, sod-houses, little frame shacks, each rising more conspicuous and impressive in its isolation than the Singer tower in New York.

"The last bread-basket," said the Master Showman, with a careless wave of the hand. "Within the year we have taken ninety-one thousand of your youngest and sturdiest from south of the line and set them to raising wheat for a world which, otherwise, would be like to starve."

"Yis," declared Tim, the Immigration Agent, Ring Master of the Wheat Country, "an' in five years they'll all be ridin' in automobiles, wearin' top-hats an' carryin' gold headed sticks, like English lords."

"I hope," put in the Pessimist, sagely, "that when they take off one of their great crops they'll be wise enough to put back a little in the way of fertilizer."

"Fertilizer, is ut?" cried the fiery Tim. "Sure th' wheat grows so high and strong now that if th' land was anny richer you'd have to cut it down wid an axe. Sure the only trouble we have wid fertilizer in this country is to kape it off th' land!"

Close to the tracks rose a tiny house of raw boards and sod. In the open doorway stood a deep-bosomed woman, two children playing about her feet. Closer still a tall man, driving four big horses, broke the virgin soil.

"Take your last look at the Man in the Shack," said the Master Showman.

"In the Middle Distance Lay a Lake of Fire."

"THE MOUNTAINS MAKING THEIR MAJESTIC ENTRANCE."

"In twenty years the continent which he has conquered will know him no more."

At eight in the evening the sun began to go to bed behind vast western curtains of green and sulphur yellow. It was a very spacious world. An hour later it was still light enough to read. In the falling dusk an indistinct gray animal lifted up its melancholy voice in protest, then loped sadly off across the endless level into vacancy.

"Bury me not on the lone pe-ray-ree
Where the lean coyote howls,"

sang the Poet, as he drained his night-cap.

Through long hours of silence and darkness the wheels spun westward, climbing the rising slope. Next morning the Master Showman—clad in a long gray dressing gown—woke us early.

"Behold," he said, "the Mountains Making their Majestic Entrance, Outrivalling in their Imperial Procession the Pomp and Splendor of the Ancient Alps!"

The car was crawling along the bottom of a deep, twisting gorge, just at the eastern border of British Columbia, hemmed in and shut off ahead and on either side by tremendous, towering peaks. For six hundred miles—two-thirds the distance from Chicago to New York—it threaded the abysmal canyons of the Kicking Horse, the Thompson and the Frazer rivers. It ran high up on the shoulders of bare, granite mountains, skirting the edge of glaciers, from which icy torrents plunged down into dim depths. It crept slowly down a twisted corkscrew of track to the bottom of a black stone bottle, stoppered with clouds, and escaped by slipping through a tunnel which pierced the base of a massive peak. It ran out of the darkness onto a spider-web bridge which leaped a flood of angry water. And still the great mountains marched by in unbroken column.

Across the Frazer River, a thousand feet above the rushing water, a narrow, endless scar lay like a black thread against the perpendicular face of the cliff.

"That," said the Master Showman, "is

the Cariboo trail. Over it, in the old days, hundreds of miners traveled to the gold fields in the North."

"How wide is the old trail?" asked the Pessimist.

"Very narrow. The man who drove stage over it still lives in my town of Calgary—he and the dog that followed the stage. Both are old and feeble now, but when the dog wags his tail he still moves it up and down, instead of from side to side. Yes, it's a very narrow trail—and old habits stick."

The Poet pointed across the river to where the trained bears of the Master Showman were clambering over the black scar left by an avalanche on the side of a tremendous hill. A little later he glimpsed, through field glasses, two moving specks on a sharp, distant ridge, which were said to be mountain goats, playing their part in the performance. And still the mountains passed.

Finally the Dyspeptic rose. "I'm going to take a nap," he said, indignantly. "I'm full of undigested scenery."

There was no sunset at the bottom of the deep canyons. Light vanished suddenly and heavy darkness fell like a fog. Around the lamp the Man from India—picked up in the middle of the mountains—told wonderful stories of the trackless jungles he had explored with a surveying party, of the wild elephants which had killed his signalmen in Burmah, of traveling thousands of miles through the wild country on a motor-bicycle. Outside the fast moving car the mountains lessened to foothills, which dropped slowly into flat table lands. The Dyspeptic snored infamously.

"The Valley Lay Like the Vast Park of Some Feudal Lord."

At breakfast there was a salt smell in the air. To the west lay a great arm of the ocean, its blue water throbbing with the slow, deep pulse of the Pacific. On the dock, in full uniform, stood the sturdy Yankee Admiral of a great fleet of British merchant vessels, waiting with his flag-ship to receive us.

"Eighty Massive Miles of Marine Marvels!" cried the voice of the Master Showman, as we walked on board. "The Golden Glories of the Gulf of Georgia!"

Far off, against the purple west rose a hundred high green and brown islands. Still beyond stood a barrier of shadowy, white mountains, climbing up to meet cloud mountains, projecting downward. The air was salt and sharp. About the jaunty white ship a great school of trained porpoises performed wonders

"WE GAZED DOWN AND OUT INTO SPACE."

of ground and lofty tumbling. Up out of the sea, at just the proper place on the program, came a great brown tramp steamer, bellowing its hoarse salute, laden with tea, silk, spices, preserved ginger, pearls, opium, manned by coolies in blue and white, smelling of the mystery of that ultimate West, which is the Far East. Down from the North, lying half hidden by the swell, crawled a tremendous sea-serpent, its body made up of a whole forest of vast fir and cedar logs, grappled together with huge chains, its lifted head belching black smoke through twin nostrils. A score of steamers, great and small, went their divers ways on as many distant errands—to Alaska after gold-dust and salmon, down to Seattle with summer tourists, across six thousand miles to Hong Kong and the Philippines.

"England out-Englished!" announced the Showman, as a sharp point of high land swung past and a compact, low-built city, drowned in green, filled the view. "Ancestral Albion Petrified and Preserved in Perpetuity!"

It was after 9 o'clock in the morning and the offices and business places of Victoria were just beginning to open. People walked leisurely about the clean and quiet streets. In the great, luxurious hotel—innocent of flashing mirrors and walls inlaid with pink marble and mahogany—a gentleman sat at table in the breakfast room. He inserted his eyeglass and stared, disconcertingly, at the servitor.

"Aw—Aw—a kippered herrin', a bit of sweets and a dish of tea," was the order.

A coach and four started at a decent pace out the road which skirts the eastern shore of Vancouver Island. Along its borders English hedge roses bloomed on trees twenty feet tall. Scotch broom covered with its mounds of yellow splendor a hundred acres of vacant ground.

"Quaint old world cottage," quoted the Poet, waving his hand generally, as we rode along, "kitchen garden; enclosed in a ring fence; grapery; stabling for two; usual offices; company water laid on."

On the ocean side there were a score of flannelled fools at the wickets and many more on the putting greens. Two tall young women, with blooming cheeks and shocking gowns, swung across the road and up a steep hill-side, followed by a frowsy Airedale. A carter, plodding beside his big horse, turned politely aside to let the coach pass. A short, fair-haired young man, in baggy rough knickers and Norfolk, the soles of his huge shoes an inch thick, came climbing up from the sea, a tail of red-faced elders panting behind him. The Master Showman touched his hat and bowed.

"Who is that?" queried the Pessimist.

"That," answered the Showman, impressively—as when Barnum points out the Blood-Sweating Behemoth of Holy Writ—"that is a second cousin of the Duke of Argyll."

At four in the afternoon a still deeper peace settled down upon Victoria. Clerks and accountants, sitting on high stools, stirred leisurely tea-cups. Shutters began to go up at office and show-windows. Tall men in high hats and long coats, women in light costumes and drooping straw bonnets, sat in little groups about the big, shadowy tea room of the hotel.

"Aw rilly!" sparkled Diana in a flowering muslin. "Well rawther!" lisped the giant beside her, twisting his drooping red moustache.

The Master Showman led his audience through the cool and quiet room. The giant lifted his blue eyes in a slow, insolent stare. "North American Chinamen," he said, calmly. "Yankee company promoters from the mainland. A bally bore!"

"THE WONDER WORK OF WATER."

"THE MOUNTAINS MARCHED UNBROKEN TO THE SOUTH."

"Well, rawther," Diana answered.

Night came in over the city. The lights went slowly out, one by one. A soft wind from the Pacific blew over the island of Vancouver. The air was faint with the perfume of roses. Victoria slept.

"Homesick?" questioned the Master Showman next morning. "A bit tired of British quiet and formality? Well, I'm going to take you back for a day to the only country where not one man in a hundred knows the words of his national anthem. The steamer for Seattle is waiting."

All afternoon and until late in the evening the saucy white ship sailed to the south and west, across the wonderful Straits of Juan de Fuca, where the ocean stretches out its many-fingered hand to clutch the land. The Master Showman turned his audience over to another Barnum. This circus was not on his lot.

Presently, against the black velvet night, a dozen great hill sides burst into sudden flame.

"Progress Personified!" cried the new barker. "The Peerless Pride of the Pacific! The Magic Metropolis of a Minute! The Hurricane of Hustle! Seattle, the Splendid, Sits Shining on her Soaring Summits! Hurry up! Get in! The automobiles can't wait!"

All the electric lights in the world were ablaze. The front of every grocery store glistened like a crystal palace. Every dentist and doctor had hung out a flashing wheel, with revolving arms—a dazzling whirl-i-gig of red and yellow and purple lights. Up and down each street rushed brilliantly lighted street cars. Men and women hurried to and fro. Automobiles, spinning round corners, speared the crowds with their long lances of flame. In the near distance bands were blaring; a ragged volley of cheers followed a marching column up the street.

"Here's the hotel," said the Barker, as the cars stopped before a tall, blazing tower. "A year ago a hill two hundred feet high stood here. Look out for the steam-shovel."

Back of the great hotel, working under flaring torches, half a dozen demoniac mechanisms bit and tore into the jagged sides of a tremendous cliff.

"Hills!" sniffed the Barker. "Hills are nothing to us. We eat 'em alive.

We filled up part of the ocean with what we dug out here. Hurry up and change your collars. We've got to get out to the exposition."

Five miles the cars ran over perfect roads, rising and falling, turning and twisting through a wonderful evergreen forest of giant firs and cedars, looking out over ocean and lakes, backed by far-off, faint mountains, their white pinnacles silvered by the moonlight.

"How old are these trees?" asked the Pessimist, lamely.

"Son," replied the Barker, a solemn note in his voice, "this forest was Primeval when Pilate was a Pup."

On the top of a great rounding hill the automobiles rested for a moment. In front the ground dropped sharply to a wide, flat valley. In the middle distance lay a lake of fire, set in a green-black forest of tall firs.

"There she is!" sang the exultant voice. "All ready and paid for on the opening date. Look! That's the air ship going up! See the blaze of light along the Pay Streak! Smell the roses! Look at old Mount Ranier, with his white nightcap on! Take my word for it, children, this is some show!"

The automobiles spun down the hill and on across the valley and presently one made out clearly the great buildings of the exposition. The foundation walls seemed built of solid masses of red and saffron roses, great white Shasta daisies and pink and purple sweet peas. Above soared airy pillars and arches of white staff. And all the pinnacles and parapets were festooned with fiery stars. Fairy land was sentinelled by solemn black firs and cedars, towering up a hundred feet. A score of fountains threw shining spray into the air. In the dim distance brooded the tremendous mountain.

"Alaska Building!" cried the Barker. "There's a million dollars' worth of gold dust in that pile on the floor! Forestry, Japan, British Columbia, Agriculture! Hurry up! The train leaves in fifteen minutes and we've five miles to run!"

Gasping, half-breathless, we foregathered, back again in the railroad car, after that wild dash through the night. The Dyspeptic's face wore an expression of agitation and agony. The Pessimist kicked viciously at the leg of a chair. Even the serene brow of the Poet was deeply wrinkled.

"Well, well, well!" said the Master Showman. "Even you Yankees from Chicago are played out. Tomorrow you shall have peace and quiet—a restful day. Get to bed now and calm your nerves." He smiled broadly. The stage was set for one of his justly celebrated dramatic contrasts.

Through the darkness the train ran northward, climbing the coast range of British Columbia and on into the vast, wild, quiet mountain country. In the pink and gray wonder of the morning the car stopped at a lonely junction rejoicing in the name of Sicamous. Presently a small, panting switch engine coupled on and went coughing away to the south over a branch line into a still wilder and more lonely country. With a final snort it stopped at the edge of a sheet of beryl-blue water, where a side-paddle steamer lay waiting us. For hours the ship steamed straight on down a great fresh water lake eight miles long. On either side rose bare brown hills, spotted with faded bunch grass and gray sage brush. The air was cool and tasted of elemental freshness. At the end waited a couple of small branded ponies, pulling a low surrey and driven by Joe 'arwood—not even irrigation will make Hs grow in cockney soil. The ponies trotted smartly down a deep gulley and up again in a curve along the high back flank of the hills. There the surrey stopped. Below on the great flat benches of land, walled by the brown hills, with white peaks showing above and behind them, lay a thousand acres of pink and white apple blossoms.

"The Wonder Work of Water!" announced the Master Showman in triumph—back again now under his own canvas. "The Dry Dun Desert Made Fruitful by Irrigation's Artful Aid."

The orchard owners lived in handsome villas, drove their motor cars through the blooming valleys, rode on blooded hacks about the mountain roads, whipped the swift-running brooks for trout. The eldest son of one was just home from a year of art study in Paris; Miss Victoria was finishing at Montreal. "Two hundred dollars an acre is the av-

"THE LAND ROSE IN SHELVES AND TERRACES."

erage net profit," said the gray-haired father, "taking ten years together. But it is not a poor man's proposition—unless he be a mason or a carpenter and can support himself during the five or six years of waiting."

That night, while the wheels hummed steadily on the back-trail eastward we sat late in the long car, talking of the ordered beauty of the irrigated orchards —ten thousand low trees, all perfect, all of a height and the same domed shapeliness, each at its exact spot in the ordered line and equidistant from its neighbors, the ground beneath as clean and carefully cultivated as a flower-bed, clear water from the mountain snows running in shallow ditches between the brown trunks—at once a thing of beauty and a work of art.

"Up in the Selkirk mountains," said the Master Showman, as we started to turn in, "live two old friends of mine, Ben Abel and Ed Brewer. Ed's brother is Mr. Justice Brewer of your Supreme Court in the States. Both are mining prospectors of twenty years' standing along the upper waters of the Columbia. I know also a couple of ranchmen in the upper valley. A month ago I sent them word by pony express that we were coming. I want you to get a glimpse of the hardships of real pioneer life. Tomorrow we'll go up the valley, a hundred miles from the railroad and pay them a visit."

"THE SHIMMERING SILVER RIBBON OF THE COLUMBIA."

"The Mouth of the Valley Blocked by a Single Tremendous Peak"

"Keep your seats, ladies and gentlemen," grinned the Pessimist, through the open door of his state room. "Gentlemanly ushers will now pass among you, selling tickets for the grand concert to be held under the main canvas immediately at the conclusion of the regular performance."

At noon the next day a big box-car stood beside us on the side-track at the little town of Golden, lying at the bottom of a high bowl of mountains. The Master Showman looked at its closed doors and frowned forbiddingly. He took off his coat and uttered a loud spell. Forthwith an Irish afrite in blue overalls came from the freight house and sent small boys scurrying through the quiet streets. Presently, out of the clouds, appeared six little grinning Japanese, a couple of tall Swedes, three Hindoos in yellow and green turbans, a Siwash Indian and a Member of Parliament. Inclined tracks of hewn logs were laid up to the opened doors of the box car, from within which came the sound of sharp explosions—both gaseous and vocal. Then—and nobody was in the least astonished—two big touring cars crept cautiously down to the ground, their engines throbbing, a leering, expectant chauffeur at the wheel of each.

"Get in," said the Master Showman, simply. "We've a hundred miles to run through the mountains before dinner."

"But——" objected the Poet, looking out anxiously at the ragged hills and tremendous peaks which walled the valley. The Poet tries always, even in his wildest flights of fancy, to keep his feet on the solid ground.

"Of course we ought to pole our flat-bottomed boats up the river," admitted the Showman, "or travel over country with pack-horses—but we haven't time for that. Hope the prospect doesn't alarm you? These mountain roads may be a bit rough, but they're really not so bad."

Still talking, he climbed into the seat beside the chauffeur and the car started. It dashed over the little bridge which leaped the icy, rushing water of the Kicking Horse, spun sweetly up a long, steep hill and straightened away on one of the high upper shelves of the valley. "Wait for you at Spillamacheen—forty miles out," he cried, with a farewell wave of the hand.

"Spillamacheen!" the Poet gasped, staring at the Member of Parliament.

"Indian name," the Member answered. "Perhaps they had a prophetic sense of humor. Get in."

At the top of the hill the road turned due south, running, level and narrow, along a ten-foot shelf cut out of the shoulder of the mountain. On that side close-growing, scraggling firs climbed up to shut out the sky. At the right the fall was sheer, the cliff dropping three hundred feet to a wide river channel, filled with light-blue, swift-running, foamy water.

"That's the Columbia," said the Member, in his best parliamentary manner. "From the source it's a big, proud, masterly river. Steamboats run all the way from Golden up to the beginning of things at Windemere and the Columbia lakes. And every spring the silver

salmon fight their way up the two thousand miles from the Pacific and the Siwashes and Shuswaps spear them in the shallows."

Just ahead, the narrow road, over which the motor purred so softly, seemed to end, jumping off into space over the side of a tremendous precipice. Power off and brakes on, the big car coasted on, turning at the edge and alcled out to the river. At the water's edge stood a tall, dead cedar. Its brown top, a hundred feet in air, was crowned with a tangle of dead branches. From it, as the car rushed by, rose a huge brown bird, its great wings lifting it in slow spirals into the blue. Its head and neck were white and, as it climbed, it screamed back hoarse curses.

"There, you Yankees," said the Mem-

"THICKLY DOTTED WITH TALL FIRS AND CEDARS."

most at right angles to run down a steep draw into the valley.

"That—" stammered the Poet, his hands instinctively clutching the sides of the car—"that was—magnificent. I hope you know the road."

"I don't think a motor has made the trip before," answered the Member. "But I ride all over the country on horseback before each election. My district is a trifle more than twice as large as the state of New York, but I know most of the roads and all the voters in it. I'll tell the chauffeur before we come to anything really bad."

At the bottom of the hill the road circber, pointing upward. "The valley's full of your birds of freedom, stealing the fish that our hard-working ospreys catch."

The southerly end of the draw was filled with an ascending series of conical hillocks, rising one above the other. The road ran circling about them, passing from each to the next higher over a high dirt fill. Twisting and turning the car climbed for eight hundred feet to the bottom of what looked to be a half perpendicular cliff.

"This is the Sinclair grade," said the Member. "From here to the top will be a test for the motor."

The chauffeur threw in the lowest speed, looked to the emergency brakes and started. Slowly, but staunchly, the great car took the tremendous grade, while the Pessimist cast down an uneasy eye in the search for thick tree-tops a couple of hundred feet below. At the very top the car straightened out again on the level shelf and the Member cried, "Now look!"

We gazed down and out into space, a vast gulf filled with sparkling, golden air. Straight below lay the shimmering silver ribbon of the Columbia, stretching away in curves through the center of the picture. From its low banks the land rose slowly in wide shelves, terrace climbing above terrace, some flat and smooth, others swelling in gentle curves. There was no undergrowth, only the ragged gray carpet of bunch grass, thickly dotted with tall firs and cedars. For five miles straight away to the west the valley lay like the vast park of some great feudal overlord, long planted and cultivated with careful art. For five miles further the foothills rose, climbing slowly up in scattered ranks. Still beyond—shutting off the world—loomed the Selkirk Mountains, peak piled above peak, the highest range jagged against the sky. From the brown foothills, the color rose in deep green and yellow, to lighten into blue and white and faintest purple on the further summits. For a hundred miles the mountains marched unbroken to the south.

Parallel with them, towering precipitously to the left of the car, the sister range of the Rockies stretched away without a gap to the south, further than the eye could follow. In the far southerly distance, centered between the mountain ranges, a dim blue lake glowed like an amethyst in its setting of green and gold. To the north the mouth of the valley was blocked by a single tremendous peak. A thick blanket of clouds was wrapped about its shoulders, its sharp white summit projecting through them into the blue. Just below the clouds a band of white grew constantly wider.

"It's snowing up there on Mount Sir Donald," said the Member.

"I think," said the Poet, slowly, "I'll get out here and build me a stone castle, with a tall tower facing the west."

For sixty miles the smooth road ran along the high upper edge of that tremendous valley, lying still almost virgin and inviolate between its mountain ranges. Then it threw itself recklessly

"IN THE DISTANCE A DIM BLUE LAKE GLOWED LIKE AN AMETHYST."

"THE DRAW AT HORSE THIEF CREEK."

in wide, dropping circles down to the bottom of a great gorge, through the center of which a swift creek plunged down to the river. Looking back the Pessimist made out a blazing bit of scarlet climbing the steep draw between the mountains.

"This is Horse Thief Creek," explained the Member, "and Red Jacket, climbing up the gorge there, is a member of the Northwest Mounted Police. They can go alone, anywhere, on their reputation. Everybody in this country knows that an injury to a mounted policeman is never forgotten and, sooner or later, is adequately punished. Sometimes a horse thief or stage robber escapes across the line from the States and tries to hide in our mountains, but on the first notice, the men on horseback start out in ones and twos from the scattered stations and search every gully and draw in the mountains, until—be it a month, six months or a year—the fugitive is captured and brought in on a led-horse or driven back again to the south."

As he spoke, the car spun across a bridge over the creek and, turning, ran into the midst of a cluster of small frame houses on the river bank. It was dusk and the long lances of light from the motor's lamps startled the people who stood talking before the general store. Another turn and we stopped before a long, low house, the door of which stood hospitably open.

"This is the house of Robert Randolph Colin Donald McTavish," said the Great White Chief, who was waiting. "Here's where you get dinner and your first touch of the trials and hardships of pioneer life."

The McTavish, himself, standing just inside, pointed eloquently to the first of the hardships, a great silver punch bowl on the sideboard. Presently, after a couple of silent, ivory Chinamen had served a dinner of which Fifth Avenue would boast for a year, the Master Showman lifted his glass of wine.

"I give you the Last West," he said. "The Last Frontier of the White Man."

"Hear! Hear!" cried old Ben Abel, the miner, wagging his vast gray beard. Out in the drawing room a big phonograph began to rattle out the last coon-song. The McTavish drew back his chair.

"Thanking You, One and All for Your Kind Attention," laughed the Pessimist, as we rose.

TO MAKE "OLE MISS" PAY

By JOHN L. MATHEWS

A COUPLE of years ago I went from St. Louis to Memphis and back on the steamboat *Georgia Lee*. We left St. Louis only a couple of days behind the schedule, and arrived in Cairo two days and a half overdue. At Cairo, in the expressive language of the river, "the niggers jumped the boat."

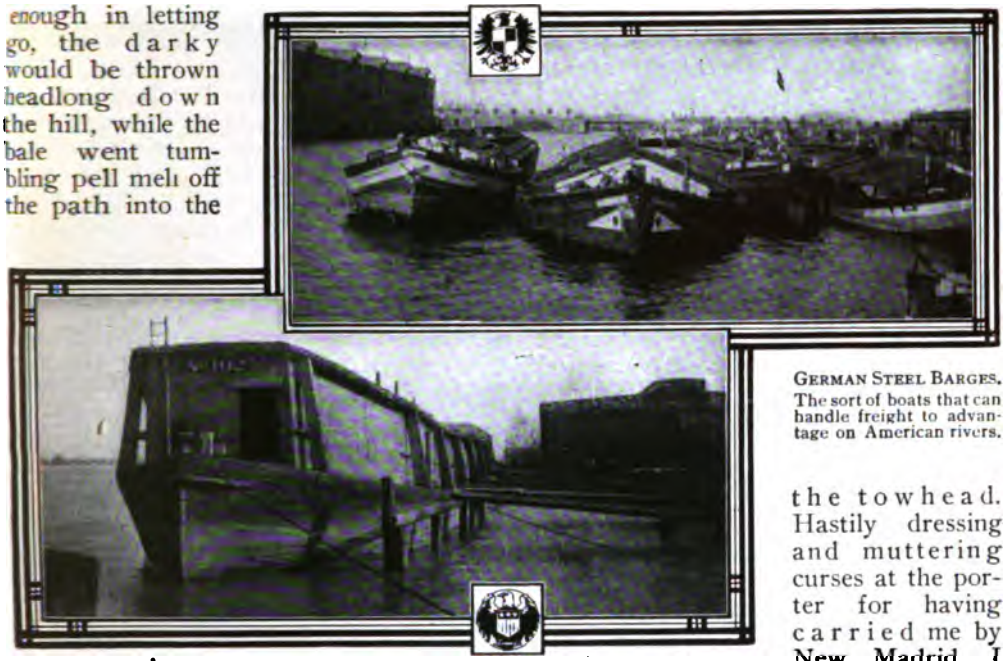
In other words, the roustabouts struck. They could make more money picking cotton, and Cairo was a good place in which to join a cotton-picking gang. It took us ten hours to get a crew of "green" negroes to handle the freight out of Cairo. We were three and a half days late at Columbus, and four and a half when we got to Memphis, owing to the difficulty the inexperienced hands had handling the cotton bales.

An old darky who is used to the river will take one end of a bale of cotton on a bank forty feet high, with an equally experienced hand on the other end; each of them will give a twist at his end of the bale with a bale hook, and no matter how rough the ground or how slippery, they will roll the cotton down the precipitous bluff straighter than it would be believed possible, land it on the end of the stage, send it racing across to the guard of the boat, give it a quick turn that directs it to the port or starboard guard, and have it in position with amazing rapidity. After which they stroll at a very leisurely gait back up the bank to look for another bale.

But a green darky with a bale hook is a very different proposition. On this trip of the *Georgia Lee,* I frequentiy saw these inexperienced young negroes start down from the upper edge of the bluff while the bale hook was still imbedded in the cotton; and, not being quick

ST. LOUIS' HANDICAP ON RIVER TRADE.
All freight has to be teamed over the steep slope and handled by roustabouts.

enough in letting go, the darky would be thrown headlong down the hill, while the bale went tumbling pell mell off the path into the



OLD STYLE MISSISSIPPI BARGE.
Heavy and awkward and drawing too much water. This photograph shows how such boats are now loaded and unloaded—over the plank gangway.

GERMAN STEEL BARGES.
The sort of boats that can handle freight to advantage on American rivers.

river. This happened not once but many times, until the mate's store of profanity was exhausted and he spoke with despairing politeness to the roustabouts.

Coming back, our experience was much the same. We landed at Hen and Chickens towhead and marooned three roustabouts who had organized a union and were about to start a strike. We marooned them too late. At the next landing the entire crew struck for a raise in wages. After an hour's delay, they got it. Before we reached Osceola they had struck twice more and their demands had been granted. At every landing the boat was hung up from half an hour to an hour waiting for them to make up their minds whether they would unload the freight.

We went out of Caruthersville about six o'clock one evening, being then six days late, and were due at New Madrid about two in the morning. As I was to leave the boat at New Madrid, I asked the porter to wake me about midnight. At daybreak I awoke and the boat was still; the engines were not running; there was no vibration; not a sound. I might have been marooned also on the towhead. Hastily dressing and muttering curses at the porter for having carried me by New Madrid, I went on deck. We were hardly out of sight of Caruthersville. We were in fact tied up at Gayoso, beside a large pile of lumber. On the lumber pile, on the grass on the levee, and under the trees which fringed it, lay our darkies; many of them heels in air; some of them throwing dice; all of them enjoying the clear air of the morning with the spirit of real gipsies.

"What is the trouble, Captain?" I asked.

The captain's reply would hardly appear well in print, but the gist of it was the crew had struck again.

"What for?" I asked.

"I do not know yet," said the captain. "They are trying to make up their minds."

As he spoke a committee, which had been consulting on the levee, evidently did make up its mind and came aboard and summoned the mate. In a few minutes the mate came stumbling and swearing up the stairway to the deck where the captain was.

"What is it they want this time?" asked the captain.

"Bread rolls for breakfast," said the mate.

There was a long and eloquent silence.

The captain could think of nothing to say. No words he had ever heard on the river in all his life were adequate to this situation. At last he swallowed hard and turned to the mate.

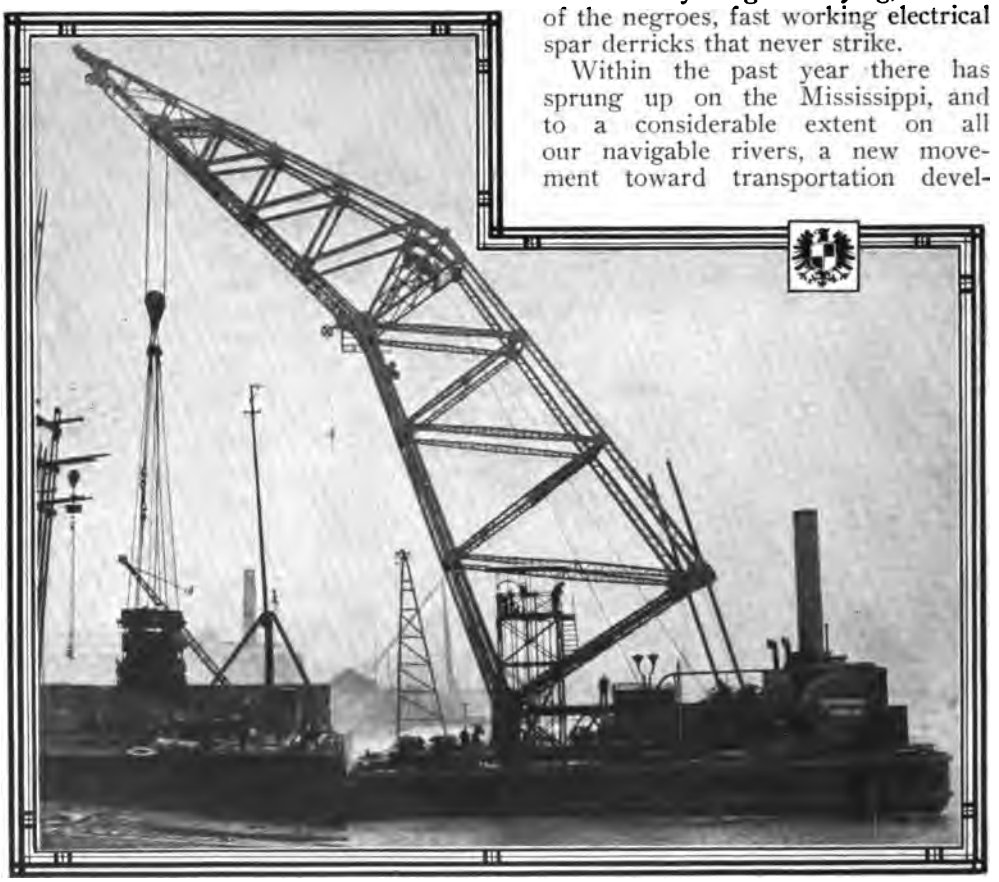
"All right," he muttered; and the mate went back and ordered the cook to prepare bread rolls for the crew's breakfast. Instantly the gang on the river woke up. The boards began coming over the bank to a merry tune and by noon we had loaded the lumber pile and were on our way across to Tiptonville.

This is not an unusual experience on the Mississippi. It is just one of many adventures that have befallen the packet boat in increasing numbers since the war time set the darkies free and left the river transportation companies with an old fashioned method of handling freight based upon slavery, which they were unable to adjust at the same time to the condition of free labor and the character of the darky.

Harris Dickson has described roustabouts and their ways for this magazine from a life of long experience with them, and I can not add to his account.

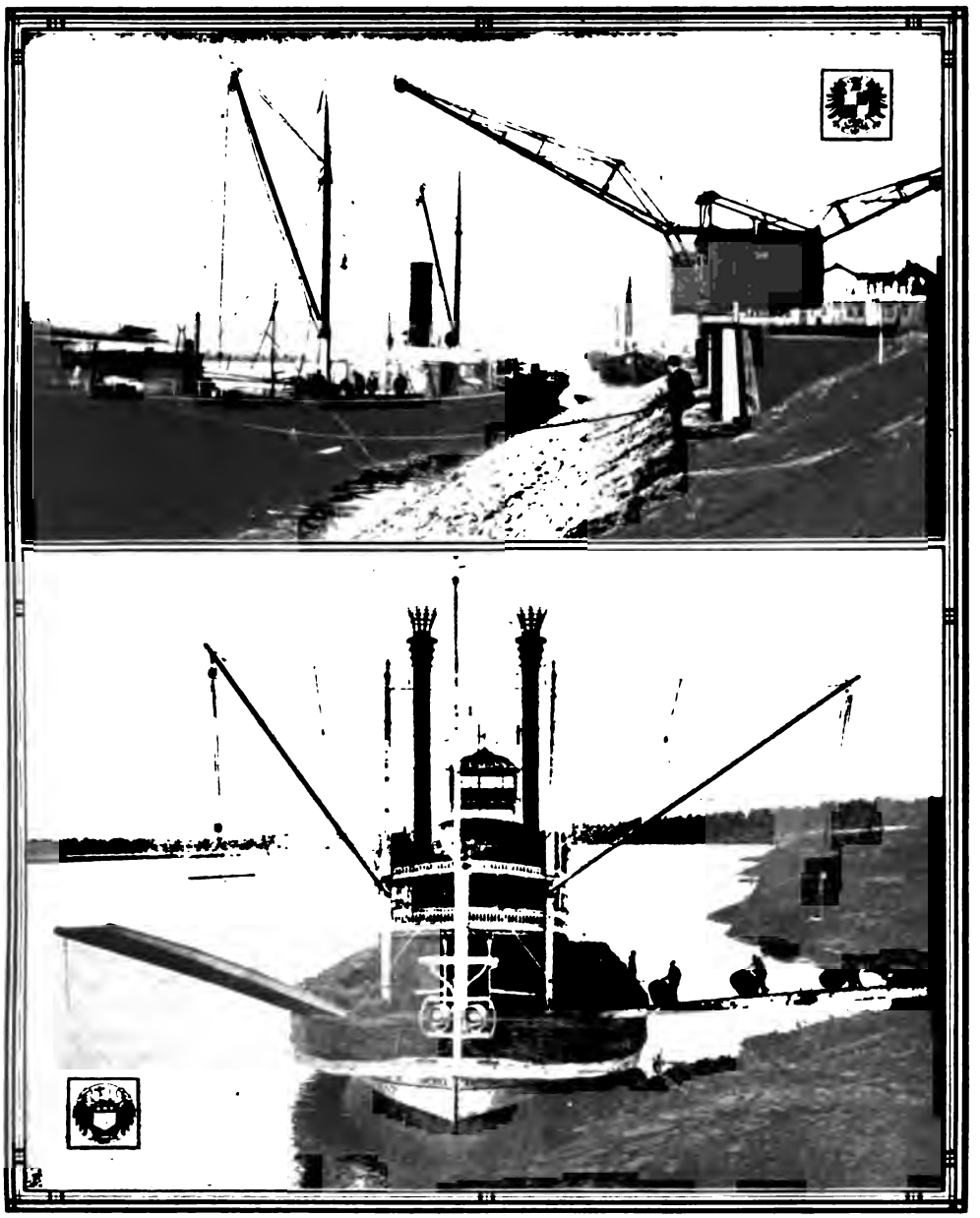
My purpose here, rather, is to describe the new methods that are coming. For the old days of the darkies are practically gone, and electricity applied through fast and powerful cranes is henceforth going to handle cargoes on the river boats from the bank to the hold and from the hold to the bank. It has been a long time coming, but now it is coming swiftly and before another year comes round, every city from St. Louis to Memphis will have its terminal docks in operation, and every cotton plantation between those cities will be served by barges carrying, instead of the negroes, fast working electrical spar derricks that never strike.

Within the past year there has sprung up on the Mississippi, and to a considerable extent on all our navigable rivers, a new movement toward transportation devel-



FLOATING CRANE SUITABLE FOR RIVER USE.

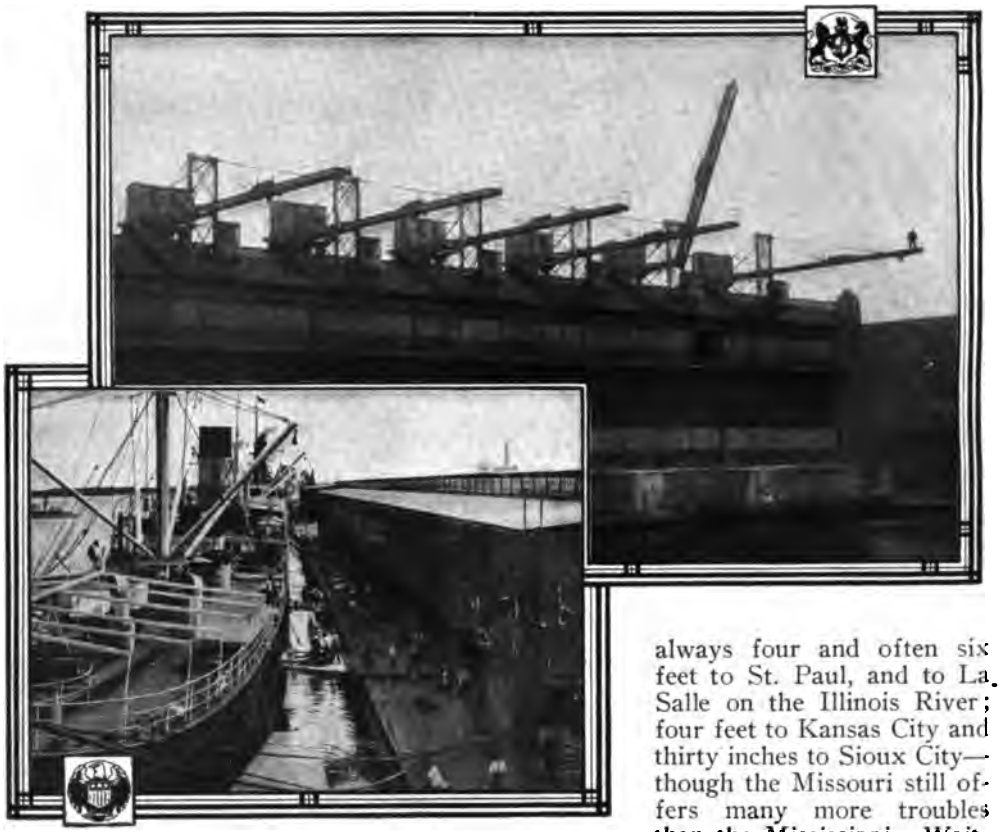
This crane lifts a burden of 140 tons. It could load merchandise of any sort on a river steamer from a floating dock.



WHERE PROFITS DISAPPEAR.

The lower of these two views shows the present Mississippi method of loading cotton by hand. Above is pictured the German method. The contrast needs no comment.

opment so radical and so remarkable that it has been difficult for the majority of the people to understand it. As if with a simultaneous impulse, the leading river and railway traffic men have taken up the study of the river as a mover of cargoes of national importance, in combination with railroads and ocean steamships, handling in part of their course the big burdens which the railways now carry with so much expense and so much difficulty. This radical change has so stirred the traffic men that every city in the Mississippi



ANOTHER CONTRAST.
Above are freight-handling cranes at Liverpool, England. Below are rousters handling freight at New Orleans, which city has the best accommodations for river shipping on the Mississippi.

Valley is turning new attention to the modernizing of river traffic.

It has brought to light several facts long lost sight of in the Valley. One of these is that there are three principal essentials for any sort of river traffic, and that a good channel is but one of them. The other two are proper boats and proper terminals. It has also made it evident that every river terminal must have a railway connection and, where possible, a belt railway, in order that river and railway may work together with the greatest facility.

The channel of the Mississippi is not ideal. It is still shifting; the banks are still cutting and caving; bars are still forming. But during two hundred days in the year barges drawing nine feet can come up to St. Louis. Every day in the year barges drawing six feet can make the trip. Above St. Louis there is always four and often six feet to St. Paul, and to La Salle on the Illinois River; four feet to Kansas City and thirty inches to Sioux City—though the Missouri still offers many more troubles than the Mississippi. Waiting patiently for a stable and definite channel, the rivermen have, nevertheless, a waterway which is well worth using and which can be made a very profitable and extensive carrier.

But to use it requires the employment of boats which can be propelled cheaply, which carry the cargo in such a way that insurance at low rates can be obtained, and which are so designed that the freight can be handled in and out by machinery at a minimum of expense. This at once bars the old-style packet boat with her wooden hull, wooden cabins and flimsy structure. With such a boat all freight must necessarily be moved by hand, the flimsy cabins forbid insurance, and the cabin structure weight forbids the carrying of much cargo on a given draft.

The passenger and freight business must be absolutely divorced, the cabins stripped off the freight hull, the wood replaced by steel, compartment bulkheads placed in the hull, and the deck

open to the sky, broken by frequent and weather-tight hatches. Freight barges, propelled by strong towboats, offer the only solution for the main through movements. Freight packets, something like lake steamers, with engines and pilot house aft, and a long, hatched deck forward equipped with two or three tall mast derricks for swinging freight to and from high banks, are the essentials for the local cotton-collecting business.

With the boat the freight handling must be revolutionized. The negro roustabout must be put off the river and the electric motor substituted for him. On the river today one piece of freight makes a load for one negro, so long as he is able to lift it. The lifting of an 800 pound box of bacon, which is the ordinary size that goes down the river, requires a gang of four to eight men; and sometimes sixteen or twenty are required to support this heavy load on the chain dogs and push and pull it by main force up a steep and slippery gully to the top of the bank. I have known a boat to take two or three hours to land two or three of these boxes.

At one of these landings offering tremendous difficulties for unloading the cargo, I have seen a boat lie for eleven hours while the negroes struggled to carry the heavy machinery of a cotton gin up a wet bank on which they could hardly secure a footing. A steamboat loaded with passengers, burning coal continuously, and consuming supplies, lay there waiting while perhaps forty negroes, drawing $2.50 a day each and their food, worked for eleven hours to land one shipment of freight on which the company received perhaps $20, or, at the most, $30 in freight.

The funniest sight I have ever seen in roustabout freighting was at Tiptonville in the neighborhood of Kentucky Point. An enterprising dealer had bought from Memphis a very considerable shipment of ink in bottles, which was brought up by steamboat. It is a common sight to see the darkies loading flour in sacks or cotton seed in bags, one sack to a load. Two husky coons stand by the banks and as the marching carriers come up they pick up one sack at a time and put it on the brawny shoulder of the next in line who marches off with it; one sack, one load. The same principle applied to these boxes of ink. Six five cent bottles, packed in sawdust and done up in a box made of veneer, weighing about two pounds, forming about a six-inch cube, made a package; and each of twenty or twenty-five darkies secured one of these packages, balanced it on his head, and solemnly marched ashore and back to a shed one hundred and fifty feet from the river where he placed his box on the pile. The spectacle of twenty-five darkies each carrying "one box, one load" from the boat to the shed

ROLLING COTTON BALES ABOARD.
This is the way the rousters handle freight. It requires strength and skill on their part—patience and money on the part of the owners.

was the most amusing illustration of American river methods that has ever come under my eye.

In contrast with this is the new method to be adopted, the using of standard sized crates, which will carry from two to four tons each of these small packages; sacks of flour, bags of seed, cement, sacks of grain, brick, tile, shoe cases, or anything that is handled in large amounts in packages, in such a way that it can be grouped in units and kept so grouped from the shipping door to the receiving door.

There will always be a very considerable river-bank business to be done upon the Mississippi or on any other river. But this business is but an insignificant thing compared with the real traffic movements which the river must serve. It is the big cargo movements between the principal towns that we are interested in as a nation, and for the establishment of this we must do away with handling altogether and substitute at every town a permanent landing place of the most modern type.

The first essential in a terminal dock is an abrupt quay wall against which the barges may lie while loading and unloading. Often this will require a floating dock or wharfboat until the banks are made stable, but even when it is a wharfboat it should be connected with the shore warehouse by some such feature as a Lidgerwood cable or other form of transfer apparatus. Preferable is the direct pier or quay upon the bank, and this can now be safely erected at St. Louis, Memphis, and most of the principal river towns where Uncle Sam has installed revetment. Along the crest of this pier must be placed a battery of traveling or pivotal cranes, operated by electricity, and capable of lifting about four tons at a load. Five or six such cranes will serve to load or unload a 2,000-ton barge by daylight of a single day and will even do better than that.

Within the swing of such a crane must be both a team road and a railway switch, so that freight so designed can go directly into waiting wagon or car. But there must also be an electric telpher, or a truck of some economical kind for conveying freight into the warehouse back of the track, and storing it there. The warehouse should have on its other side a team platform and an additional railway track. The time will come very soon when, in connection with such equipment will be used such box cars as are seen at Tehuantepec, from which the roof can be lifted by the crane and all freight lifted in and lowered into place without manhandling.

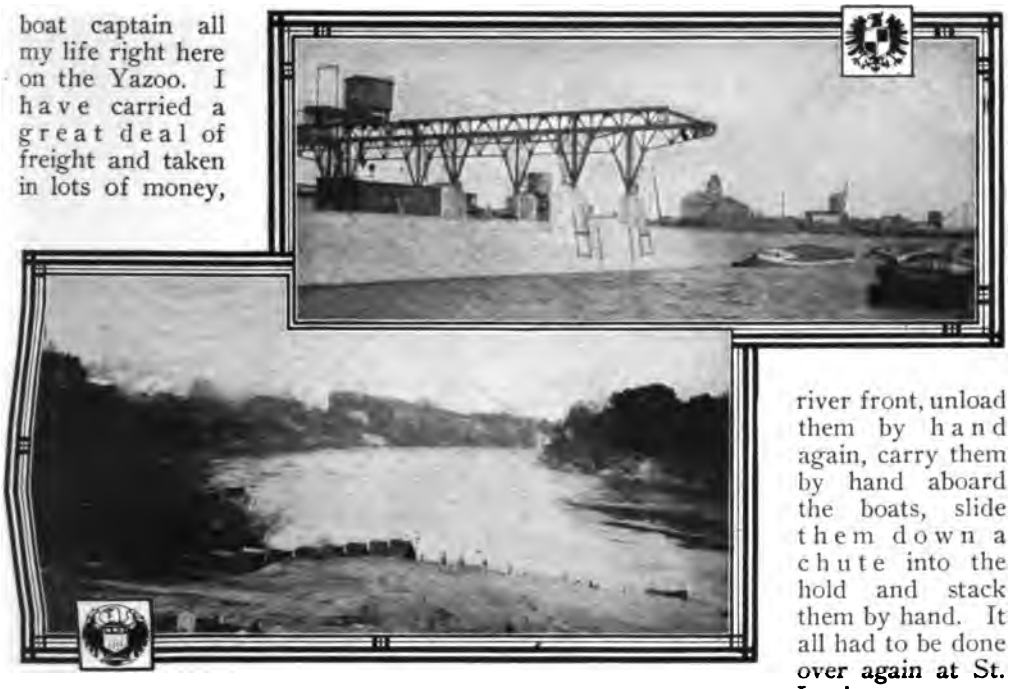
The cost of electric power for lifting freight from the boat up to the level of a wharf above highest high water is about two-tenths of a cent a ton. The whole operation of transfer can be accomplished under favorable circumstances for four cents a ton and should never exceed ten cents. Against this contrast the cost of such railway warehouses as are used by the Missouri Pacific, excellent of their kind, yet in which house goods, so-called, cost forty cents a ton for trucking from the team through the freight depot into a box car and the same for unloading. Sometimes this cost reaches sixty or even seventy cents a ton.

With the old type boat such a warehouse and crane equipment would be of little or no value. But with the long-decked barge, which is to be adopted, with its frequent hatches, every bit of cargo can be placed or withdrawn from overhead with the utmost facility.

Some of these new methods as they are used abroad I presented to an audience at Vicksburg one night in December through the medium of some lantern slides and a stereopticon. One of the pictures which was shown, was one which appears with this article of the steamboat *Choctaw* lying at Greenwood landing on the Yazoo River, loading hay, which is being brought aboard from a wagon by negroes, each of whom crosses a gang plank and comes down the guard with a bale of hay on his head. I may remark in passing that they are stacking the hay immediately alongside the boiler under the passenger cabins, so as to get a good start for one of those typical old-fashioned river conflagrations.

When I threw this slide on the screen and called attention to it, an old gentleman in the audience rose up and interrupted me. "I want to say right here," he said, "about that picture there, that you all know that I have been a steam-

boat captain all my life right here on the Yazoo. I have carried a great deal of freight and taken in lots of money,



river front, unload them by hand again, carry them by hand aboard the boats, slide them down a chute into the hold and stack them by hand. It all had to be done over again at St. Louis.

LANDINGS THAT DIFFER ESSENTIALLY.
Above is a coal-tip at Breslau, Germany; below a landing at Montgomery, Alabama.

but I have never made more than a fairly decent living; and sometimes I have been in debt at the end of the year. I never knew where my money went to until right now. Mr. Mathews has shown me. I have been paying the money out all my life to that line of negroes there carrying freight up the bank; and I never knew where it went."

It is very unusual to get an old river man so quickly converted to modern methods.

With loading facilities and freight-crates designed and built, and with the proper boats provided, the river traffic man reaches out after many big movements in which the river has never been a factor. At Minneapolis, for example, there is produced every year 1,600,000 tons of flour, of which 600,000 goes to export.

By river? Down the old road to New Orleans? Not a barrel or sack of it. All by rail, overland, to some seaport.

The old boatline, the Diamond Joe, used to have it put in cars, pay a local switching charge for the ten miles to St. Paul where the navigation ends, unload the sacks by hand, team them to the

But the new method will be very simple. If we cannot send barges up to Minneapolis to load, we will run a switchtrack to the boat side, build our own cars with removable roofs, handle the sacks in crates of two tons each, load and unload by electric cranes through the car roof, and in a single swing put each crate into its place in the hold. Twelve hundred tons on four feet draft make a steel barge load; 2,200 tons on six feet. And it is handled out the same way at New Orleans.

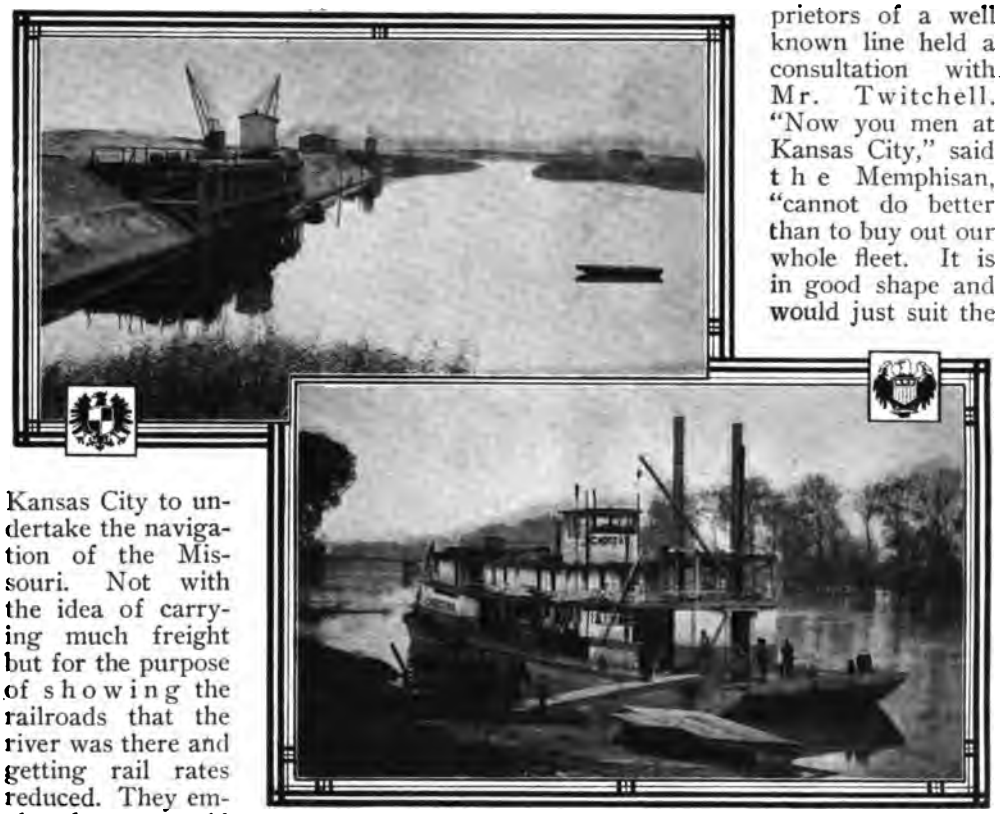
That is the new business, the modern business. When it is compared with the "one box one load" roustabout it recalls the Boston Irishman and his newly invented mechanical cotton-picker.

"What are you going to call it?" someone asked him.

"The motor-paced nigger," he replied on the instant.

Some such phrase might well be used to describe the enlivening of river transportation by these electric installations. But there is as much change in boats as in terminals. For about boats the river man has been learning a great deal.

In 1908 a company was formed at



TYPICAL RIVER TERMINALS THAT TELL THE WHOLE STORY.
River landings of Germany and America. The latter is only a mud-bank.

Kansas City to undertake the navigation of the Missouri. Not with the idea of carrying much freight but for the purpose of showing the railroads that the river was there and getting rail rates reduced. They employed two old boats; a tin hulled sternwheeler called the *Chester,* and a wooden hulled one named the *Tennessee,* and made several trips during the season. The last trip is still incomplete, for anyone coming into Kansas City during the winter of 1908 might have seen the cabins of the *Tennessee* beside one of the Missouri River bridges, sticking out of the water over her battered hull, which had been pierced by one of the Missouri River snags. An uninsured cargo had gone to the bottom, and the three hundred and eighty-sixth boat had paid its toll to the snags of the Missouri.

In October of last year, I went down the Mississippi on the steamboat *Quincy* in President Taft's party. One of the passengers on our boat was Mr. Jerome Twitchell of Kansas City, a member of t[illegible]ny with which I am associ[illegible]so of a new line organized in [illegible]y to put freight boats on the [illegible] At Memphis, one of the proprietors of a well known line held a consultation with Mr. Twitchell. "Now you men at Kansas City," said the Memphisan, "cannot do better than to buy out our whole fleet. It is in good shape and would just suit the Missouri River trade." Mr. Twitchell is a quiet and reserved gentleman who seldom indulges in open bursts of humor; but his eye unmistakably winked as he said, "When you sell a Kansas City crowd an old boat again, you will have to come early and catch us asleep."

There will be many new types of boats designed for river use in the next few years. Electrical propulsion of gangs of barges is a possibility. But the best fleet which has yet been designed consists of a towboat of 2,000 horsepower and big 4,000 ton steel barges.

This steel barge with a thirty foot rake at each end tows with remarkable facility, and drops in the water about an inch for every fifty tons load, drawing fifteen inches light. Thus it carries 600 tons on thirty inches, 1,200 tons on four feet, 2,200 on six feet, and 3,985 tons on full draft of nine feet. The largest barges ever used heretofore on

the Mississippi carried 1,500 tons on twelve feet draft and were useless at low water. This barge is of quarter-inch steel plates, divided into numerous compartments, and every part of its hold accessible for a grab bucket. It will carry coal, grain, cement, or the highest class of package freight, at the lowest rate of insurance given to first class vessels.

To propel these barges is a problem on which the engineers are now applying themselves. The present plans call for a light steel towboat, one hundred and fifty by thirty-three by six, drawing thirty inches with fuel aboard and with double compound engines developing 2,000 horsepower.

On the present draft of water between St. Louis and New Orleans, these towboats will be able to propel five of the large barges at a trip, taking them downstream well filled, with 17,000 to 20,000 tons at a journey, and bringing them up lightly loaded, with perhaps 6,000 tons at a trip. So loaded, the towboat should descend in five to seven days and return in eight, making with all allowance for delay, a round trip every three weeks, or seventeen round trips a year, with a capacity for each towboat of 460,000 tons of freight a year. These barges can come to a point on the Illinois within ninety-five miles of Chicago. For the Missouri, similar barges will be used; but it is planned to armor them on the long rakes with half inch steel plates to make them puncture proof.

As for the effect on rates, we may examine the case of Batesville, Arkansas, head of navigation on the White River. No boats now run there, and Batesville, though not far from St. Louis, pays ninety-six cents on first class goods. That is more than the rate from St. Louis to Boston. Following its usual custom, the steel barge line can offer a rate from St. Louis via the main trunk line and its White River division, of sixty per cent of the railway rate, or about fifty-six cents a hundred, a saving to Batesville of eight dollars on every ton, or about eighty dollars on every minimum carload of jobbed goods sent in. Yet that rate is high enough to allow the river company leeway for fighting and at the same time to assume the risks of a rather dangerous river.

As the river idea grows the public is beginning to realize that the rivers can only be used by big corporations, if each company has to erect its own docks and sidetracks, and its own warehouses as well as to provide its own boats. This idea has struck in in St. Louis quite strongly, and the newspapers of that city are carrying on a campaign for an efficient public terminal. The construction and operation of the terminal docks by the public is common in Germany and found always profitable. Montgomery, Alabama, has adopted this plan and is building a warehouse and freight elevator.

This is a new movement but it is advancing with remarkable speed. Next year the Mississippi will carry 1,500,000 tons of freight of a sort it has never carried before. In ten years it will carry 20,000,000 tons. In time this will force the Deep Waterway if we do not get it otherwise; but without the Deep Waterway, with the channels we have now, and with the other two elements developed to high efficiency, the Mississippi will soon be on the traffic map of the world as a significant international factor.

Peace Be Around Thee

As half in shade and half in sun
This world along its path advances,
May that side the sun's upon
Be all that e'er shall meet thy glances.

—MOORE.

HOW TO SAVE COAL

By JOSEPH W. HAYS

CONSERVATION of our National Resources!" Great subject for magazine articles —grand rallying cry for the government. A great deal has been said and written, but how much of a practical nature has been accomplished? Little can be done until the private citizen is aroused, and he takes a very languorous interest in the conservation propaganda. "The government may conserve if it wants to and future generations may look out for themselves, just as this one is doing." Such sentiments may not be commendable but they have to be considered, inasmuch as they are human.

A little thought will satisfy us that the conservation of private material interests is to a great extent the conservation of public ones. Show the individual that he is suffering an actual loss in his own personal resources and he will wake up and take notice. The loss that hits his pocketbook is a concrete one and a concrete proposition is usually interesting; it is sometimes exciting. It requires an imaginative mind to become enthusiastic over an abstraction, and, say what we will about the waste of national resources, it is an abstract subject to the average person.

We shall make no progress with this work of conservation until we enlist the private citizen, and the only way to get him is to show him what he is losing. Conservation like charity must begin at home. Dollars by the hundred million are wasted annually in the United States, because we do not understand the elementary principles governing the economical use of fuel. This waste is inexcusably unnecessary and every private citizen is affected by it. If you are not a consumer of fuel, your landlord is, and rents are based largely upon the costs of operation and maintenance. It is easy to stop these wastes and the purpose of this article is to show what causes them and how they may be eliminated.

We have been reading much about our coal deposits and their probable lifetime. "A frigid time is coming, two hundred years hence, more or less, when coal will be found only in museums." It has been mathematically demonstrated that wood cannot be grown fast enough to meet the demand for railroad ties, not to mention fuel. How will our children's children's children warm themselves when the coal measures are exhausted? What will they burn under their boilers? When you talk this over with your neighbor it doesn't worry him, and the discussion results in conserving nothing for future generations. Now show the man that he spent a hundred dollars to warm his house last winter when eighty would have been ample. He sits up and listens. He wants the lost twenty, for more coal bills are coming. Show him where the loss occurred and how to stop it and you have accomplished a practical result. There will be at least a little coal left at the expiration of the two hundred year limit.

Coal is wasted in mining and handling to be sure, just as the magazine writers tell us, but the greatest of all the unnecessary fuel wastes takes place after the coal has reached the stove or the boiler furnace. I have suggested twenty per cent. of the fuel as illustrating the extent of this waste, but the figure is probably below the average. The loss is as high as fifty and sixty per cent. in some cases, and it may be as low as five or ten per cent. if the furnace is unusually well managed. Chemistry shows us how to eliminate the unnecessary waste altogether.

This waste of coal in the burning hits the consumer harder than it does his great grand-children, for the costs of mining, of transportation and handling and the profits of producer and dealer are all added to the value of the coal after it leaves its geological resting place. All these costs are met by the consumer, and coal that is worth a dollar a ton at the tipple, may sell at four or five times that amount to the man who burns it. Conservation of our coal supplies by reducing consumption is, accordingly, of vital, present day interest to us, whatever interest this or any other means of conservation may have for the unborn generations to follow.

We have little use for a doctor who sends in a bill with his diagnosis. What we want is a prescription and a cure. The assertion that we waste twenty or some other per cent. of our fuel unnecessarily, may alarm but it does not help us. How can we stop the loss? That is the "burning" question. It is incumbent upon the writer to point out the means of saving.

FIG. 1. A STUDY IN COMBUSTION.
The smoking wick is exposed to the air on all sides. The draft is insufficient.

In a general sense, coal is coal and combustion is combustion. It makes no difference whether we own a cook stove or a battery of 500 horse-power boilers. We find, of course, in actual practice, that coal of one class can be treated to best advantage in one way and coal of another class in another. The limits of this article are such that we must confine ourselves to the general principles governing the economical consumption of fuel, without reference to the character of the combustible or the purposes for which we are burning it.

Combustion, as every one knows, is a chemical operation. Heat results from the union of oxygen with the combustible. Two problems present themselves when we seek to burn any fuel with economy:

FIG. 2. THE SMOKING HAS CEASED.
The chimney creates the right draft.

1st. The problem of getting all of the heat out of the combustible.

2nd. The problem of putting the heat where it belongs after we have extracted it.

The heat energy in the lump of coal is dormant or potential. The function of combustion is to transform this energy into a usable condition. The problem of "getting all of the heat out of the combustible," is merely a problem of burning or oxidizing all of the fuel.

Some heat is necessarily radiated and lost and some combustible is usually wasted with the ashes. These losses are often of great importance, but we will not consider them, confining ourselves to those detected in the chimney.

The chimney loss is determined, first, by the quantity of combustible escaping with the waste gases and, second,

by the temperature and volume or weight of the air and products of combustion passing up the chimney.

It is commonly supposed that the greatest losses incurred in the burning of fuel are due to incomplete combustion. This, like many other things, "commonly supposed," is a great error. I have named these losses first and will first consider them. While very large in some instances, the popular mind has greatly overestimated them. The losses covered by the second problem mentioned, will, in ordinary circumstances, be ten times those embraced under the first.

Three combustibles are found in coal—carbon, sulphur and hydrogen. We will confine our inquiries to the carbon and what happens to it in the furnace, as this element constitutes the principal part of the combustible, and in some coals, as, for example, the anthracites, practically all of it.

FIG. 3. A CARD HAS BEEN PLACED OVER THE CHIMNEY.

When carbon is burned it leaves the solid state and combining with oxygen forms the gas carbon dioxide or CO_2, commonly but incorrectly called carbonic acid gas. When a pound of carbon is completely burned it yields 14,500 British thermal units or 8,080 pound calories. When it is half oxidized the gas CO, or carbon monoxide, is formed with a loss of 10,100 British thermal units. It is accordingly important to burn the carbon and all of it to CO_2.

Certain conditions are necessary to the complete combustion of carbon:

There must be a sufficient supply of air, for we cannot oxidize the fuel without oxygen and air contains this necessary element in its free form.

The temperature of the furnace or fire-chamber must be high enough to promote chemical union. Hydrogen and some fuels can be ignited at relatively low temperatures, but carbon in the solid state must be heated before it will manifest any interest for oxygen. Graphite, which is a form of carbon, cannot be burned except in the presence of tremendous temperatures. High temperatures are necessary to burn soot—the disagreeable thing that gives employment to the smoke inspector. It is commonly supposed that smoke once formed cannot be burned. This is a mistake. The fact that it is very rarely burned after being formed, is no warrant for the belief that it is non-combustible.

The oxygen must be brought into immediate contact with the combustible—there must be an intimate mixture of the air with the combustible gases.

The flame must not touch a cold surface or combustion will be checked and carbon precipitated.

The above are the requisites of complete combustion and the absence of any one of them will be the occasion for smoke and much of it. The writer finds that few people are acquainted with these elementary things and a kindergarten illustration will be of advantage.

Let the steam engineer, who does not understand why the chimney of the plant in his charge is a smoking nuisance, provide himself with an ordinary kerosene lamp and study combustion at close quarters.

When the wick is first lighted, the flame smokes. See Figure 1. Turn the wick "down" and the smoke diminishes if it does not cease altogether. The smoking flame is of a yellow or reddish color, while the smokeless flame is white, perhaps approaching "incandescence." Lack of oxygen, or what amounts to the same thing, excess of combustible, accounts for these phenomena. There is an ocean of oxygen all around the smoking flame, but nothing to cause a flow of the gas

in sufficient quantity over it. It is necessary to decrease the combustible or increase the supply of oxygen. We must turn down the wick or put on the lamp chimney.

Smoke ceases when we put on the lamp chimney—see Figure 2.—As the air is heated within the chimney, a draft is created and oxygen is continuously supplied by the current of air flowing over the flame. Atmospheric pressure pushes the colder and heavier air in through the screen at the base of the chimney, displacing the hotter and lighter air within and driving it out at the top. Draft is, accordingly, not a "pull," as its name implies, but a push, and the regulation of this push is one of the most important things in connection with the economic use of any fuel.

If we should obstruct the draft through the lamp chimney, in any manner, as by placing a card over the chimney top—Figure 3—or wrapping a handkerchief about the base of the chimney—Figure 4—the flame will at once begin to smoke and this condition will continue until the obstruction is removed or the wick turned down to a point where the supply of fuel is commensurate with the supply of air—see Figure 5.

FIG. 4. THE HANDKERCHIEF PREVENTS THE INFLOW OF AIR.

We will next take a piece of cold metal, an iron washer for example, attach it to a piece of wire and suspend it within the chimney in contact with the flame—Figure 6—The moment the cold metal touches the flame, smoke occurs and will continue until the metal becomes very hot.

Some very instructive facts are developed when we study temperatures in connection with these lamp experiments:

We note, for example, that the temperature is much higher in the case of Figure 2 than in that of Figure 1, although the wick is at the same height in both cases and the same quantity of fuel is being consumed.

We note also that if we turn the wick still higher and consume more fuel, as in Figure 7, that the temperature is lower than in Figure 2.

Referring now to Figures 3, 4, and 5, we note that the temperature resulting from the low flame of Figure 5 is greater than that accompanying the higher smoking flames of Figures 3 and 4.

These experiments teach us that the temperature may be lowered by increasing the fuel out of proportion to the air supply, or by increasing the air supply beyond the requirements of the fuel. This applies particularly in the first case if a hydro-carbon is being burned, as in the case of oil or bituminous coal.

We have now demonstrated that lack of oxygen—or excess of fuel—lack of temperature and interfering cold surfaces are the three prime causes of smoke, or incomplete combustion.

The fuel loss due to such incomplete combustion is determined to a great extent by the cause of the smoke. If the cause should be lack of air or lack of temperature, the loss might be considerable, as half burned carbon, CO, would accompany the soot. If the smoke should be occasioned by a chilling surface, the loss might be very immaterial, as nothing but soot might result. A small quantity of soot, owing to its finely divided character, is sufficient to impart a pronounced color to a large quantity of chimney gases. The percentage or degree of smoke is, accordingly, no index at all of the wastes chargeable to incomplete combustion. Nothing but an analysis of the gases

will determine the extent of such waste. While CO and soot, usually keep company with each other, we may have much black smoke and little or no CO or no smoke at all and much of it. The gas, CO, may be given off in large quantities from a fire of coke or anthracite. The "clear" chimney is not, as commonly supposed, prima facie evidence of an economical furnace.

The problem of "putting the heat where it belongs" after we have released it from the combustible is the most important in connection with the economical generation of steam power. The heat belongs to the water in the steam boiler and when we take the heat away from the boiler and send it up the chimney, we are interfering with economy in one of the most effective ways that characterize the bad boiler room practice of this country.

FIG. 5. THE CARD IS STILL IN POSITION.
But with wick turned down the supply of air is adequate.

We must put some heat in the chimney, otherwise there would be no draft and draft is the life of fires. The greater the draft, the faster the fuel will be consumed and the greater will be the percentage of the available heat discarded to the chimney. If it is a question of how much fuel we can consume, then the more draft the better. If it is a question of economy —how little fuel we may consume and keep the plant going —then the least draft we can employ, consistent with a proper combustion, the better.

Suppose we send 10,000 cubic feet of air and gas up the chimney in a given time, heated to a temperature of 500 degrees. This volume of gas and this temperature represent a certain waste of heat energy. It must be evident that if the volume should be doubled without changing the temperature, the loss would be doubled also. The temperature usually rises as the volume is increased, for volume frequently depends upon velocity, the greater the velocity of the gases the shorter will be their time to associate with the heating surfaces of the boiler.

Cases have come under the observation of the writer where enough air was passed through one boiler furnace to supply the combustion needs of fifteen of them. What shall we say of an engineer who will permit such furnace room practice and what shall we say of a manager who will retain such an engineer? In the average steam power plant, the air supplied to the boiler furnaces is about three times the economical requirement. This statement is based upon a personal examination of over two hundred boiler rooms. There will be little conservation of our coal supplies until we revolutionize furnace practice. The revolution will be accomplished when we have popularized the work of flue gas analysis. Nothing but an analysis

FIG. 6. COLD METAL TOUCHING THE FLAME CAUSES SMOKE.

of the escaping gases and an intelligent use of the data obtained, will enable us to materially reduce fuel consumption.

It must not be assumed that a knowledge of chemistry or any particular expertness is necessary to the work of flue gas analysis. Any fireman of common intelligence is chemist enough for the purpose. In ordinary circumstances the determination of the percentage of CO_2 in the gases of combustion will be sufficient for practical purposes. It is a very simple operation. A sample of the chimney gases is pumped through a pipe into a glass measuring tube, transferred from this tube into another containing a strong alkali, returned to the original tube and remeasured. The alkali absorbs the CO_2, and a scale on the measuring tube gives the percentage of absorption. Apparatus adapted to this purpose has been on the market for all of fifty years and no coal consumer need be without it.

The percentage of CO_2 in the chimney gases is a direct measure of the efficiency of the furnace. If the furnace is operated as it should be, there will be about 14 per cent. of it. The following table may be of interest in this connection:

Per cent. CO_2.	Per cent. air employed.	Per cent. fuel loss.
15	138	12
14	147.8	13
13	159.2	14
12	172.5	15
11	188.1	16
10	207	18
9	230	20
8	258.7	23
7	295.7	26
6	345	30
5	414	36
4	517	45
3	690	60
2	1035	90

At 1 per cent. CO_2 the air supply is 2,070 per cent. of the theoretical requirement and the efficiency of the furnace is practically nil. The average boiler furnace will show about 5 per cent. CO_2 and the possible saving may be found by subtracting the unpreventable loss of 12 per cent. from the actual loss of 36 per cent., as shown in the last column.

Find the method of furnace operation that will produce the highest percentage of CO_2—this is the method that will run your power plant with the least fuel. There are, of course, some exceptions to this rule and the engineer should provide himself with good, practical literature dealing with the subject of flue gas analysis and furnace management. There is plenty of it in print.

FIG. 7. THE WICK TURNED HIGH.
More fuel is being consumed with less heat than in Fig. 2.

The savings that can be effected by bringing chemistry to bear in the boiler room are almost beyond belief. A large corporation, owning a half dozen scattered mills and manufacturing a staple commodity, placed a combustion "crank" at the head of its power department. At one of the mills, the average daily fuel bill was $493. The average daily coal charge is now $190 and the "load" at the mill has been increased 13 per cent. Without taking account of the increased load, the fuel reduction has been over 61 per cent. and the annual saving $110,595. I can hardly expect that these statements will be believed. The coal bills of this corporation and other indisputable data were submitted to the writer. At no one of the half dozen mills has a saving of less than 25 per cent. been effected. I have in mind

another large manufacturing corporation. Its stockholders are scattered all over the world. Its daily coal bill runs into the thousands of dollars. The furnaces of one of its principal power plants are running with less than 2 per cent. CO_2. If the power departments of the other plants are as wastefully conducted, the daily unnecessary coal loss is away up in the thousands. Some day the stockholders of manufacturing corporations will wake up and demand a record of the CO_2 averages with the annual report of the directors.

It is often urged that the remedy for all furnace troubles is the mechanical stoker, or self feeding furnace. Such an appliance is not in itself a remedy, for we cannot entirely eliminate the human element in the equation. The most economically operated power plants in the Chicago "Loop District" are fired by hand, and within a gunshot of the plant in question is another one, equipped with mechanical stokers, and, with respect to the consumption of fuel, about the most wasteful that ever came under the observation of the writer. The mechanically fired furnace has a very proper engineering application in many cases, but it is not necessary, either to smokelessness or economy.

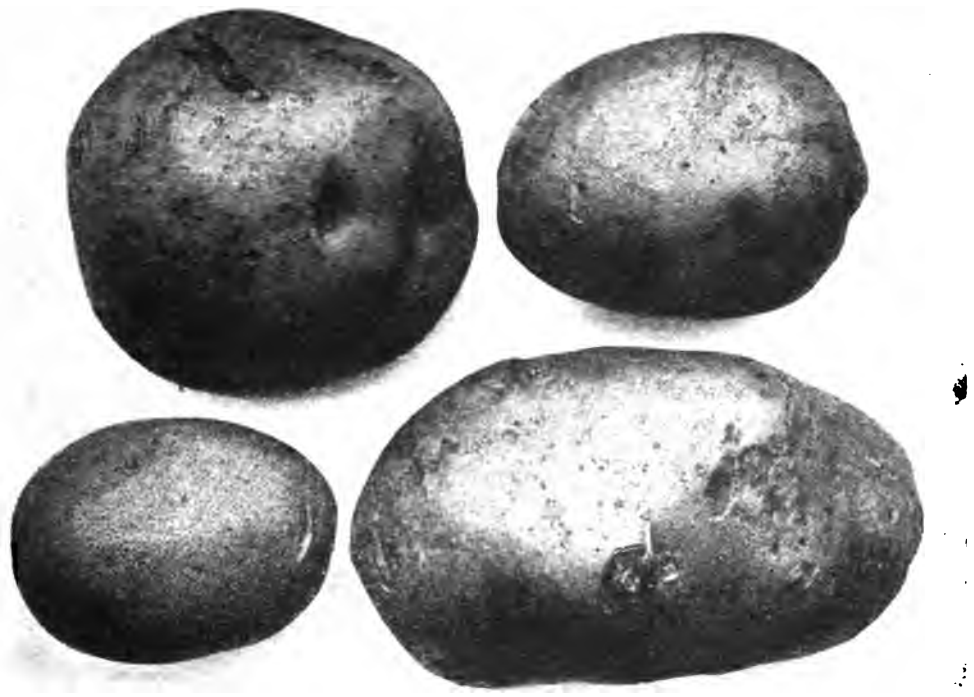
It is well that the remedy for fuel wastes does not lie with the mechanically fired furnace, which is an expensive contrivance. About eighty per cent. of the steam power plants of the country are under 500 horse-power. Fully sixty per cent. are under 200 horse-power. The small plant in many cases could not afford the cost and there are frequently insurmountable objections in addition to the financial ones. Highest economy can only be attained in any event through the means of flue gas analysis as a guide to the correct method of furnace operation.

A Requiem

Under the wide and starry sky,
Dig the grave and let me lie,
Glad did I live and gladly die,
And I laid me down with a will.

This be the verse you grave for me;
Here he lies where he longed to be;
Home is the sailor, home from the sea,
And the hunter home from the hill.

—Robert Louis Stevenson.



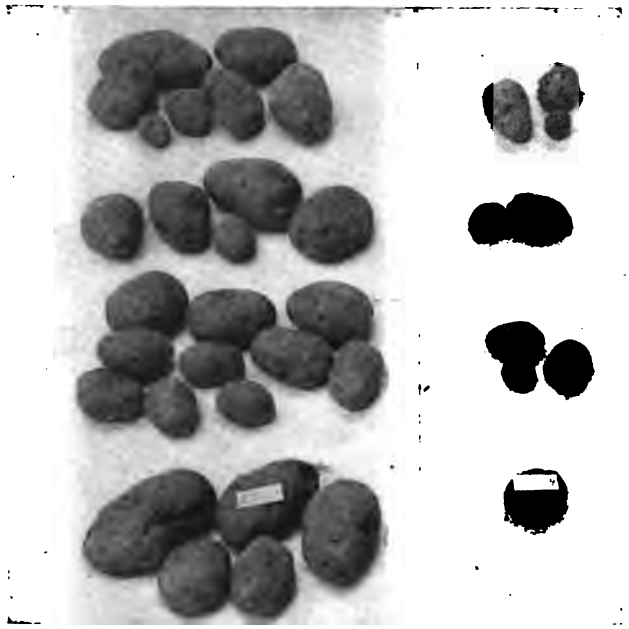
POTATOES OF THE SIR WALTER RALEIGH SPECIES SHOWING DESIRABLE AND UNDESIRABLE SHAPES.

The upper right-hand tuber is about the right shape and size. The one to its left is ill-shaped and too large. Of the bottom pair, the one at the left is well-shaped but too small; the other too long and too large. The photo is about one-half the size of originals.

EVERY FARMER A POTATO BREEDER

By GUY ELLIOTT MITCHELL

LAST year the farmers of the country lost 125,000,000 bushels of potatoes, worth at the prevailing average price on the farm, $75,000,000. To explain this statement, had American potato growers adopted a simple process of seed selection, as demonstrated by the various agricultural experiment stations, they could, without additional cultivation or fertilization, have increased their yields forty per cent., if not more. It is well worth while for the potato grower, whether he be an acre or a 50-acre grower, to maintain a little potato breeding plot. It will pay several thousand per cent. of profit over the investment of trouble and labor. Profitable results are as sure and certain as in the case of breeding seed corn or wheat, and the process is fascinating and at the same time exceedingly simple. The average potato yield of the United States is ridiculously small, the range being, during the past ten years, from sixty-five bushels to one hundred and ten bushels per acre and averaging for that period less than one hundred bushels. The farm price has varied during this decade from forty-one cents to seventy-six cents per bushel. This fluctuation in price accounts for the oft heard statement that a man never knows whether it is going to pay to plant potatoes. However, there are over



GREAT VARIATIONS FROM APPARENTLY IDENTICAL SEED POTATOES. Burpee's Extra Early.

3,000,000 acres planted in potatoes annually in the United States, and if it is worth while to plant at all it is just as well to get that additional forty per cent. yield.

Few farmers can afford to breed animals in the extensive way necessary to secure important results, owing to the expense; but no man is so poor that he cannot afford to have his breeding plats of potatoes, corn or wheat, and if he realized the increased hard cash that they would bring him, no farmer would neglect starting them at once. Almost everybody raises some potatoes; yet it is stated that probably less attention has been given to the improvement of potato seed by farmers generally than to any other factor of their cultivation. In this connection it should be understood that the potato is essentially a crop in which the conditions should be studied with reference to each individual farm. The farmer cannot afford to depend too much upon the seedsmen nor even upon his immediate neighbors for seed. There is scarcely a crop, too, in which there is greater variation in the seed, and for this reason there are larger possibilities of increasing the yield than with other crops. In other words you can't judge a potato's performance by its appearance.

Here, in brief, is the plan: The first thing to determine is the best variety for the farm and, as stated, not to depend on what may be considered best for the adjoining farm. No general crop is more influenced by environment than the potato. So that unless the farmer is pretty well grounded in the belief that he knows what is the best variety for his farm, it will be advisable to first determine this fact by planting small plats to a number of the supposed best standard varieties. This need not, however, interfere with at once starting the breeding plat of the supposed best variety. For the breeding plat a piece of uniform, average ground should be selected and given the same fertilizing and cultivation that is given the regular crop, nothing more. Then a type of potato should be selected of the variety which it is proposed to breed up to a higher standard of production. It should be a moderately large potato, somewhat cylindrical and not spherical in form and with shallow eyes. The next step is to examine a large number of potatoes and pick out at least 1,000 as close to the type potato as possible. Each tuber should be cut into four uniform sized pieces, quartering it lengthwise so that each piece shall contain an equal proportion of stem end and bud end. The plan now is to plant a group of four hills from each tuber with a view to ascertaining the productive capacity of that tuber. The breeding plat should preferably be checked and a skip left between each set of four hills. A good procedure, to avoid mistakes, is to drop the whole potato to each group of four hills and then go over the row again and quarter it.

Digging the breeding plat should be done carefully by hand, the potatoes from each group of four hills being thrown together. Now for the selection of the best

potatoes to start the strain of seed which will give the largest yield of good merchantable potatoes of the best shape and appearance. The first step in this regard is to go over the plat roughly and pick out tentatively the best 200 piles out of the 1,000, and next, with a pair of scales which will record ounces, and a note book, select the best fifty piles. These 50 piles, then, represent the product from the best fifty potatoes of the original 1,000 potatoes selected at planting time. They should be placed in paper bags, to be later examined with more care, and if the farm work crowds at this time they can be stored for final examination during the winter. The good potatoes from the discarded one hundred and fifty piles should be retained to plant a general crop next year and they will be found to yield considerably more than the average run of seed potatoes.

EARLY BEAUTY OF HEBRON.
On the left are four hills from the same seed potato—a light yielder; on the right four hills also from a single seed potato—a heavy yielder.

For seed for the second year's breeding plat, the bags should be gone over carefully and the ten best potatoes selected from each. This will give five hundred potatoes for the second year plat, presumably the best five hundred potatoes from the first year's breeding plat, and quartered will plant 2,000 hills for the second year plat. These are to be planted in the same manner as were the first year's seed—in tuber units. It is desirable and interesting, for comparison's sake, to plant about every tenth row with average unselected seed of the same variety. The production of these check rows will show what progress is being made in improvement. In the third, fourth and following years the same plan should be followed and the reward cannot fail to come.

In short, the plan is, to select each year from the breeding plat the yield from the fifty best seed potatoes and to further select from each of these the ten best tubers for the following year's breeding plat seed; and second, to provide improved seed for the general crop from the next best groups after the breeding seed has been selected. The general improved seed supply will always be just a year behind the breeding seed.

Potatoes of the same variety differ widely, as stated, and the grower must be continually on the watch for the appearance of heavy yielding strains. When such a strain is discovered all the further selection should be made from that strain.

At the Wooster Agricultural Experiment Station, two hundred hills were planted as above described. The best one hundred hills were dug and weighed and the best ten hills selected. Ten hills were planted from each of these ten best hills, or one hundred hills; also one hundred hills from the poorest yielding hills of these one hundred best hills, and one hundred hills from the remainder of the one hundred best hills with no reference to individual hills. The following figures show the results from these three plantings:

TREATMENT	Total yield of 100 hills		Average yield per hill.	
	lbs.	oz.	lbs.	oz.
Seed selected from best 10 hills out of 100 best hills..	125	6	1	4
Seed selected at random from 100 best hills.....	115	1	1	2.4
Seed selected from poorest hills out of 100 best hills...	81			12.9

These figures show a great variation in yields all from the one hundred best

hills of the two hundred planted, while even the yield from the poorest hills must have been considerably greater than the average yield from potatoes planted in the ordinary way.

To show further the tendency of the potato to retain the parent characteristics, the experiment was carried through the following year. From one hundred hills selected from the lowest yielding hills of the year previous, the product was seventy-five pounds, while one hundred hills from the ten highest yielding hills of the year previous product one hundred and seventy-two pounds and one hundreds hills from the potatoes selected at random the year previous yielded one hundred and thirty-six pounds.

To demonstrate the variation in potato seed, in 1907 the agriculturist of the Washington State Experiment Station planted two plats of potatoes, one with seed selected in the field from the best looking hills of the 1906 crop and the other with seed from medium to poor hills. The yield from the latter was sixty-one sacks per acre while the yield from the plat planted with tubers from the best hills was eighty-one sacks per acre. Here was a gain of twenty sacks per acre from the first year's selection without any previous breeding.

A MILLION FOR A SMOKE EATER

By JOHN HOUSTON McINTOSH

ONE million dollars—more money than any man can save in a lifetime working for salary or wages—awaits the inventor who can give to the world an appliance, no matter how simple, which will consume smelter smoke. Smoke consumers are used with success in many of the large cities of our country, but the smoke in such cases issues from ordinary heating plants burning coal or wood. Smelter smoke contains fumes and gases from the roasting ores and thus far the human mind has failed to find an influence that will combat the poisonous effect of the smoke which fills the atmosphere in the vicinity of every smelter.

This million dollar reward for the successful inventor is no fairy tale or pipe dream. The big smelting companies of the United States have spent many times

EXPERT WITNESSES FOR THE DEFENSE—THE ANACONDA COPPER COMPANY—STUDYING CONDITIONS IN THE DEER LODGE, MONT., VALLEY.
The farmers claimed the fumes from the smelters ruined crops and injured stock.

BUTTE HILL. SHOWING THE THREE GREAT COPPER MINES OF THE ANACONDA COMPANY.
From this hill one-third of the world's copper supply is taken.

that amount fighting damage claims or settling with damaged and disgruntled neighbors. A year ago the Guggenheim interests, which practically control the smelting trust, publicly offered $500,000 for a successful smoke consumer and the offer was duplicated, though unofficially, by the Amalgamated Copper Company, which runs some of the largest smelting plants in the world.

As an illustration of what a costly proposition this smoke business is, the Amalgamated Copper Company, or the Anaconda Copper Mining Company, which is a subsidiary concern, is still in the throes of a deadly struggle with a portion of the population of Montana over the question of smoke damage. True the company drew first blood through a recent court decision, but the people have asked for a rehearing of the case and in the event it is refused they threaten to appeal to the United States supreme court.

Recently an eight million dollar smelter was closed by the people of Utah on the grounds of smoke damage and the smelter owners everywhere await with anxiety the final outcome of the great Montana suit which will probably be accepted as a precedent for all similar cases.

DR. V. A. MOORE, OF CORNELL UNIVERSITY, INVESTIGATING THE SMOKE CASE.
He used a fence corner for a laboratory.

The story of this gigantic case, which involves a billion dollars' worth of property, and which is, in reality, the biggest injunction suit of modern times, is interesting.

Firmly organized and financed, the Farmers' Association of the Deer Lodge Valley of Montana, petitioned the Federal court at Helena for an injunction which would close the great Washoe Smelter of Anaconda, built at a cost of $13,000,000. It was declared that the plant had become a public nuisance by reason of the constant issuance of poisonous smoke and fumes from the towering stack. The petitioners admit that victory for them would mean death to Montana's biggest industry—the mining and smelting of mineral ores—and practical starvation of 50 per cent of the state's population, now about a half million souls, but they claim to have settled in the country first and that the smoke is bringing them to ruin.

In answer to this the Anaconda Copper Mining Company states that the real damage is nominal; that the suit was not brought in good faith but as a

means to force the company into settling on a cash basis exorbitant damage claims, and that the management is doing all that is possible to eradicate the cause of complaint and possible injury.

The first gun of this stupendous legal battle was fired May 9, 1905, when the

DID THE SMOKING CHIMNEY DO THIS?
Experts for the Farmers' Association declared this sore in the horse's nose was caused by smelter smoke. Company experts testified that the sores were due to fox tail plants, a complaint common with stock in many regions.

case was formally opened. The fortunes of war perched first on the banner of the Farmers and then of the Company until early in the present year when the latter won what appeared to be complete victory, a decision of the court refusing to grant the injunction. The Farmers' Association, however, says it's far from beaten and that unless the application for a rehearing is granted the case will be taken to the Supreme Court of the United States for final adjudication.

Away back in the early sixties the Deer Lodge Valley, one of those fertile tracts which lie in strips between the northern ranges of the Rockies, like green oases in a desert of naked ruggedness, saw its first white settlers. They were farmers and small merchants from Indiana, Iowa, Ohio, Illinois and Missouri. Virginia City brought its fleeting thousands with the discovery of gold at the grass roots, and as suddenly became a deserted village with the baring of the bed rock. Last Chance Gulch, on the spot where Helena was afterward located, likewise had its rush of gold seekers and one small band of empire builders settled in the Beaverhead country. But the Deer Lodge Valley seemed the favored spot of the territory. The lucky miners from Virginia City and Last Chance Gulch went there to settle down.

After the working out of the placer camps, Montana was given up as a mining state until Marcus Daly, the enterprising Irishman, whose foresight later brought him millions, guessed the future demand and value of copper, and bought from a prospector for a song those three claims destined to become the world's greatest copper producing mines—the Anaconda, the St. Lawrence, and the Neversweat. That was in 1880, and the time of the birth of Butte. Today Butte, with her 75,000 inhabitants, is the greatest mining camp on earth, and the mines, the workings of which lie directly under the streets of the place, give to the world one-third of its copper supply.

With the growth of the camp and the increase in the output of the red metal, smelters for the treatment of ore became a necessity, and a comparatively small plant was erected within the camp's limits. Later, another was built. Considerable ore was also roasted in heaps on the flats below the camp and in those days Butte was rightfully called the "Smoky City," for the smoke from the stacks of the smelting plants and the roasting ore heaps enveloped the landscape like a blue cloud through which the rays of the sun scarcely ever penetrated.

No sooner had Marcus Daly come into possession of his "Hill" group of mines than he began casting about for a suitable location for a smelter of his own. Not wishing to add to the smoky atmosphere of Butte he selected as a site a

spot less than a mile distant from the town of Anaconda, an hour's train ride from Butte. There, also, were plenty of lime rock, timber, and water, without which no smelter can be operated.

Anaconda, the county seat of Deer Lodge County, is laid out near the center of the valley's agricultural activities. It is certain that the Copper King never dreamed the locating of his smelter in the Deer Lodge Valley would antagonize the ranchers and stir up a hornet's nest of discontent, else he would have chosen some less fertile spot for the erection of the plant. Marcus Daly, however, never lived to experience the trouble. He died when in the midst of promoting big schemes and his copper interests were taken over by the Anaconda Copper Mining Company for an estimated consideration of $50,000,000. This company later became a subsidiary concern of the Amalgamated Copper Company, which virtually controls the price and output of the world's copper and which has made its Montana holdings bigger and more valuable than ever.

When the Titanic corporation took over the copper industry in Montana in 1899 it undertook the completion of a new smelter shortly before started by Mr. Daly. The old works, or "Lower Works" as they are now called, were located across the wide gulch from the present Washoe plant. The old works had treated the ore from the Daly properties since 1883, but the smoke was carried away from four comparatively short chimneys and the plant was in other ways inadequate to treat the increased supply of ore. At the outset the new smelter was supposed to cost $9,000,000, but when completed in 1902 it had cost the corporation $13,000,000. It is the greatest and costliest plant of the kind in the world. It is set on an eminence looking down from the southwest corner of the valley.

The human mind can hardly grasp the bigness of the plant even with a personal inspection. This is what it takes to feed its great maw every twenty-four hours: ten thousand tons of ore from Butte; 2,300 tons of lime rock from adjacent quarries; 650 tons of coke; one thousand tons of coal, and it consumes 35,000 gallons of water per minute. Instead of four small smoke stacks there is one great one. It is 350 feet in height, forty feet in diameter, measured from the inside, at the base and thirty feet at the top. The top of the stack is 1,100 feet above the valley.

Still another, but smaller, plant is owned by the company at Great Falls in the northern part of the state, and these two smelters handle and treat practically all of the ore mined in the Butte hill. The Great Falls smelter is largely dependent on the Washoe plant for its existence and operation.

The Butte district acts as feeder for the smelters. The figures showing Butte's production of wealth as well as its consumption of raw products are, to the layman, indeed startling. Its mines hoist 15,000 tons of ore every twenty-four hours. They employ directly more than 10,000 men. The Amalgamated mining payroll in Butte is about $40,-

THE CAUSE OF THE ORIGIN OF THE "SMOKE CASE."
The giant smoke stack of the Washoe Smelter. Hourly, tons of smoke fumes and dust issue from its mouth. This stack is 350 feet high.

000 a day. Something like one thousand millions of dollars in ore have been taken from the Butte hill and it is believed there are three thousand millions yet stored there. The underground workings of Butte's mines aggregate 1,000 miles. It takes 400,000 tons of coal annually to keep the mines and smelters running. This gives some idea of the enormous extent of Montana's copper industry.

THE JUDGE WHO TRIED THE "SMOKE CASE."

William H. Hunt, whose decision is regarded as one of the ablest and most comprehensive ever handed down by any court.

Without the Washoe smelter the mines would close and once closed they are practically worthless. Butte, with its ever busy population, is as dependent on the company's payroll to its miners as a baby is dependent on its mother for food. Anaconda is entirely dependent on the smelter which, in turn, cannot run without the product of the mines. And Anaconda's population approaches the 20,000 mark. Great Falls, with her 25,000 inhabitants, is likewise helpless without the operation of mines and smelter. There are 4,000 men on the company's payroll at Great Falls and 3,500 at Anaconda. In addition the company operates elsewhere in the state a big coke plant, several coal mines and two immense lumber companies, all of which are feeders to the mines and smelter and which give 5,000 more men employment.

When it is considered that a large part of Montana's agricultural products find their markets in the towns named and go towards the support of the families on the payroll of the Amalgamated Copper Company, it is easy to conceive that 250,000 people, at least, are directly or indirectly dependent on the operation of the Washoe smelter for support. It is therefore plain that the great plant at Anaconda, which the Farmers' Association seeks to close, is the key to the state's industrial situation and that the closing of the smelter would irreparably cripple Montana for many generations to come.

Admitting all this the Farmers' Association, on the other hand, contends that many ranchers of the valley owning in the aggregate more than 50,000 acres of land, will be eventually ruined if the smelter continues to run. They claim priority of rights in that they were in the valley long before the smelter made its appearance. When Fred J. Bliss, head of the Farmers' Association, was reminded that the number of people receiving possible injury from the smoke is small as compared with the number who would be adversely affected by the closing of the plant, he said: "That's admitted, but whose rights are to be considered first, the farmers of the Deer Lodge Valley who settled there a half century ago and who reared their children as successors to the soil, or a corporation whose presence in the valley runs back but a decade?"

Naturally when the case was brought several years ago the mass of the people trembled to think of what the outcome might be. And at that time, though many of them bought their bread with the pay they drew from the Company, they secretly sympathized with the farmers and hoped the smelter people might be punished in some way that would not cost them their jobs. As the trial progressed, however, sentiment changed. It looked as if the actual smoke damage had been somewhat exaggerated and that, until the company believed it was being held up, it had willingly settled all claims and had paid out to the farmers of the valley, first and last, $500,000. There came a time when the Company refused to treat further with the claimants and the latter in turn declared they wouldn't accept further damage money, even if payable—that they would close the smelter for all time and thus rid themselves of the nuisance.

And after the suit was brought it was injunction or no injunction, a sort of life or death proposition. The court was not called upon to decide or award damages. The question meant the company's very existence. Like the jury sitting on

a first degree murder case and obligated to either hang or acquit the accused, the court could do but one of two things: shut down the smelter or allow it to run.

The momentous question, on which hung the prosperity of a state and which meant possible harm no matter how decided, was put squarely up to William H. Hunt, judge of the United States District court for Montana. Judge Hunt is a product of the Roosevelt regime. He and the ex-president of strenuous persuasion have been lifelong friends. He was appointed governor of Porto Rico by Roosevelt and when he later expressed a desire to return to the states the president promptly placed him on the bench of the Federal court. Cool and calculating, yet decisive; a close student of the law; brilliant, William H. Hunt has few equals as a jurist. As a citizen he stands high in the public esteem. His record, both private and public, is unassailable.

The average judge would have shrunk from the trial of a case of such stupendous proportions, but not so with Hunt. He relished the arduous work of untangling the meshes of evidence and weighing with his evenly balanced legal mind the facts as produced by hordes of witnesses on either side. Not having the time to give the case his entire attention or to hear personally all the testimony, Judge Hunt appointed as master in chancery for the taking of evidence, Oliver T. Crane, a Helena attorney of attainment.

Both the company and the Farmers' Association made extensive preparations for the presentation of their respective sides of the case. The company sent to the front to command the guns A. J. Shores, head of the legal department of the Amalgamated Copper Company. Mr. Shores at first superintended the legal battle from the company's side, but was later succeeded by his assistants, Con. F. Kelly and L. O. Evans, who really did the bulk of the work from the start. Kelly is known as the most brilliant young lawyer in Montana. His mental ability was discovered by Marcus Daly. The financier took Con. Kelly out of the Anaconda mine and sent him to Michigan where the latter received his education. Kelly returned to Montana and worked his way up from a clerkship in the legal department of the company to the executive legal head and today is the right bower for the big system he represents. Evans is a close student and an able pleader and the two form a strong team working in double harness.

The Farmers' Association was represented in the great struggle by Robert L. Clinton and C. M. Sawyer. Mr. Clinton, like Kelly, is a comparatively young man but stands high in his profession, and not the least interesting feature of the case was the daily verbal skirmish between the leading luminaries of the different sides.

Master in Chancery Crane held court in the Federal building of Butte and the taking of testimony was formally begun on the 25th day of April, 1906. It was stated that the Association expected to prove the smelter was not only a public nuisance but a menace to health and to prosperity; that the smoke, fumes and dust from the mighty stack of the Washoe plant is carried by the wind as far down the valley as the mountain walls will allow and that disease and destruction to organic life is transmitted with it; that horses, cattle, sheep, and swine had ceased to thrive and that the raising of live stock was a profitless task; that the grain and gardens and fruit and flowers had been blighted and that the very soil was contaminated by a poisonous sulphur deposit; that property value throughout the district had woefully de-

OLIVER T. CRANE.
Master in Chancery who took evidence in the "Smoke Case."

preciated and that even human life was no longer safe from the acute ravages of the smoke.

Admitting that the ranches in the immediate vicinity of the smelter had suffered to some extent, the defendant company declared in reply that the owners had been amply repaid for the damage done; that beyond this the injury was grossly exaggerated; that the farmers, realizing they could no longer "bleed" the company for damages, determined out of pique to ruin it; that the plant had been built at an immense cost and that to close it would mean financial panic to the stockholders and death to the company's copper industry in Montana; that every possible effort had been made to discover a consumer for the smoke and dust but inventors had failed to find any appliance that would give relief, even though they knew such an invention would mean fame and fortune for them; and that the suit, after all, was but a big conspiracy formed to force the company to buy up all the ranch lands for miles around, a scheme that from the defendant's standpoint, would prove impractical as well as impossible.

DR. H. C. GARDNER.
Noted veterinary expert for the smelter company. His services cost the defense $100 a day.

There followed then the costliest, longest, biggest and in many respects the most remarkable trial of an injunction suit in the history of equity courts as growing out of the old English common law.

It was evident from the outset that one serious obstacle loomed up between the Farmers' Association and success and that the Anaconda Copper Mining Company faced two powerful influences prejudicial to its cause. Had the Farmers' Association included in its ranks *all* the ranchers of the valley it would have been hard to conceive of failure to close the smelter, but several hundred farmers refused to join what they called the "Smoke Crowd," and one of the accepted principles of equity is that before a public nuisance can be defined as such its annoyance must be general in the community. It cannot bother Bill Smith here and fail to bother Tom Jones over there, and constitute a public nuisance.

Arrayed against the Company were the influences of public opinion, which seldom favors a corporation, and the executive branch of the government at Washington, D. C., which, laboring under the impression that the smelter smoke was injurious to the forest reserves, sent expert employes to the scene who were later called into the case as witnesses against the Company.

Though there were but eighteen months occupied in the actual taking of testimony the case, first and last, extended over a period of four years, including the time used in pleadings, arguments, recesses granted by the court and vacations and holidays. Neither side at first anticipated such a struggle, but as the case progressed the fight became bitter and no expense was saved to make a showing. In all 350 witnesses were examined, including some of the country's greatest scientific experts; several trainloads of exhibits were offered in evidence; a small army of stenographers took down 25,135 pages as part of the records, which means 7,540,500 words; and before the case closed the company had spent $3,000,000 to defend and the Farmers' Association $500,000 to prosecute.

Among the prominent men brought into the case as witnesses by the company were Dr. Duncan McEachran, chief veterinarian for the Dominion of Canada; Dr. Leonard Pearson, dean of the veterinary department of the University of Pennsylvania and official veterinarian for the state of Pennsylvania; Dr. V. A. Moore, dean of the veterinary department of Cornell University; Dr. Theo-

THE COW THAT QUICKLY FATTENED.
Purchased from a "smoke" farmer by the company's agents. This bovine, fed on hay grown near the smelter, gained 175 pounds in 35 days.

bald Smith, professor of comparative pathology at Harvard University; Dr. Charles A. Doremus, an eminent toxicologist of New York City and formerly associated with Bellevue hospital; Prof. Ralph E. Smith, plant pathologist of the University of California; Prof. F. W. Traphagen, head of the metallurgical department of the Colorado School of Mines, and last, but not least, Dr. H. C. Gardner, Montana's state authority on veterinary science.

Dr. Gardner was the chief adviser of counsel for the company throughout the hearing and by reason of his knowledge of animal and plant conditions in Montana, was of invaluable aid to the other experts, most of whom were brought from great distances to study conditions and then tell the master in chancery of their observations.

Nor did the Farmers' Association fail to make a showing with a strong array of eminent experts. Among others, this side presented Dr. D. E. Salmon, former chief of the United States bureau of Animal Industry; Dr. Robert Formad, head of the laboratory department of the same bureau; Dr. E. T. Davison, federal inspector stationed at Helena; Prof. R. E. Swain, professor of chemistry at Leland Stanford University; Prof. W. D. Harkins, professor of chemistry at the University of Montana; M. E. Jones, a geologist of recognized standing, and W. E. Weigle, of the United States forestry service.

The majority of expert witnesses on both sides were brought to Montana and employed to make a study of conditions throughout the state, compare these conditions with those of the Deer Lodge Valley, and testify according to their findings. All of those for the Company and several for the Farmers were in the state for a year or more before being called to the stand. Some idea of the cost can be obtained when it is known that some of the experts were paid as high as $100 a day each and all expenses.

With its powerful financial backing the corporation left no stone unturned which might strengthen its case. Through its agents it purchased a big tract of land about five miles from the smelter, including the south half of the Bliss ranch, and opened an experimental ranch of its own. This ranch was stocked with cattle, horses and swine and fed on hay and other products grown right on the place. And right there the company played its strongest card. It contended all through the hearing that the run-down condition of the majority of farms in the "Smoke Zone" was due to lack of thrift and care; that these same farms had been producers until the "Smoke Case" was started and that then they were allowed to go to seed as a good illustration of the smoke damage contention. And the company farm was run to show what reasonable industry might produce.

OFFERED BY THE FARMERS AS EVIDENCE OF SMOKE DAMAGE.
This horse had to be lifted to his feet for the picture.

In the meantime the witnesses for the Association were testifying that the hay and food stuff for stock was impregnated with arsenic poisoning which proved slow death to animals fed upon it. To back up this theory the "Smoke Farmers" presented countless specimens of diseased organs of animals and poor samples of grain and alfalfa.

Then the company sprung its specimens. "If the hay poisons the cattle and stock on your farms why doesn't it have the same effect on those of our ranch?" demanded Attorney Kelly as he offered in evidence perfect specimens of animal organs and grain and hay as fine as the West can produce.

Again the company scored and this time with the tools of the opposition. It was shown that miserable specimens of cows and horses had been purchased from the ranch of Fred Bliss, the leading complainant, and had been properly fed and properly taken care of on the Company ranch. The results were startling. Some of the cows had gained five and six pounds a day, while fed solely on hay raised in the valley, and had been transformed from scurvy, rawboned animals into sleek, fat and contented cattle.

L. O. EVANS.
One of the leading lawyers for the smelter side of the case.

And referring to this coincidence Attorney Evans said, in summing up his argument before Judge Hunt a year later: "The only possible conclusion that can be drawn from the wonderful improvement in the cattle and stock when bought from the complainants and fed by the defendants is that the farmers who brought this case wasted their time, neglected their soil and allowed their animals to hunger. They preferred that their ranches should waste away and their cattle starve so that the cry of 'smoke damage' might have apparent evidence to back it."

During the progress of the case cows, steers, horses, hogs and sheep were slaughtered in numbers so that post mortems could be held over the dissected carcasses. Times without number the Farmers' Association produced horses with ulcerated noses and cows with tumors and running sores, offering them as evidences of smoke damage. The company experts met this with counter testimony that the sores and ulcers were maladies common in all cattle herds and that they were not caused by contamination with the vomit from the smelter stack.

"The animals and crops are badly damaged by smoke in the Deer Lodge Valley," said the experts for the Farmers.

"You are wrong," replied the Company experts, "for they are no worse off than in other parts of Montana, except on the ranches wilfully neglected."

So contradictory were the statements made by the experts of the two sides that Judge Hunt determined to make a personal tour of the valley himself. He wanted a general idea of conditions as they actually existed and he wanted this idea first hand.

Through his investigations he found that the average wind velocity down the valley was seventeen miles an hour. He learned that atmospheric conditions were dry and that the wind with an absence of humidity reduced the possible damage from smoke to a minimum. He saw for himself the giant smoke stack emptying to the aerial world thousands of tons of dust and smoke and he walked carefully over the strip of ground three miles long and a mile and a half wide which seemed particularly blighted by the smoke. He examined the Bliss ranch and noted its depleted condition. He also made a mental observation of an adjoining farm which seemed thrifty enough. Here he found a ranch where sub-irrigation had been indulged in until the ground had become swampy and practically useless. And just over the

hill he found the Company ranch on an adjoining strip of land which had been drained by tiling and which was a model for tidiness, system and productiveness.

By the close of the summer of 1908 the evidence had all been submitted and Master in Chancery Oliver T. Crane prepared and submitted to Judge Hunt his exhaustive report of the findings. Judge Hunt spent the winter in deliberations and consideration of the case, and on January 25, 1909, his decision was handed down.

It was a victory for the company.

The court's decision is one of the most comprehensive ever given by a Federal judge. It deals with the case from every angle and demonstrates an exhaustive knowledge of the questions involved. In it Judge Hunt declared that some damage had undoubtedly accrued from the smelter smoke, but that this was nominal when the extent of the damage claimed was considered. But the court did not hold the company entirely blameless. The Anaconda Copper Mining Company was commended for its efforts towards removing the cause of complaint, but was warned that its efforts had not been altogether successful and that further improvements must be made or the Company would be held to account. The Farmers' Association, however, now thoroughly embittered by the long war, promises to push its cause harder than ever.

In the meantime the company's ranch, which was started for experimental purposes during the tedious trial lasting four years, is now being run as a practical proposition under the personal and able direction of Dr. Gardner.

The members of the "Smoke Association," as it is known to some, are awakening to real thrift, and the residents of the valley not members of the Association are pointing with pride to the fact that the hay and grain crop harvested last year is the best in the valley's history. To top it all a monster petition is being circulated through the state bearing in big gold letters over 100,000 signatures the four simple words:

"Let us have peace."

Patriotism

Breathes there a man with soul so dead
Who never to himself hath said,
"This is my own, my native land!"
Whose heart hath ne'er within him burned
As home his footsteps he hath turned
From wandering on a foreign strand?
If such there breathe, go, mark him well!
For him no minstrel raptures swell;
High though his titles, proud his name,
Boundless his wealth as wish can claim—
Despite those titles, power, and pelf,
The wretch, concentered all in self,
Living, shall forfeit fair renown,
And, doubly dying, shall go down
To the vile dust from whence he sprung,
Unwept, unhonored, and unsung.

—SCOTT.

THE CARVING OF THE WINDS—SAND WAVES.

WHERE LAND FLOWS LIKE WATER

By RENÉ BACHE

THE "live" sand dune is a serious menace in many parts of the United States. Much effort and a good deal of money have been expended by the government in trying to control it, but in vain. It remains today an unsolved and perilous problem.

A sand dune of this kind is a devouring and remorseless monster. It is a hill, sometimes attaining the size of a small mountain, which, instead of remaining stationary in one spot, continually travels. Anything useful to man that happens to be in its path is destroyed utterly. It swallows up houses and even villages; the cultivated fields over which it makes its dreadful march are converted into hopeless desert.

For ten years past the government, in an experimental way, has been fighting the dunes. It has used for the purpose every means which the ingenuity of science could devise, but without success. No human artifice seems able to check, save in very temporary and incomplete fashion, the march of the traveling sand hills; and it has not been found practicable to render them stationary by planting them with sand-binding grasses, because the latter will not grow on their constantly-shifting surface.

The problem is particularly serious along the Columbia River, in Washington and Oregon, where immense damage has been done to cultivated fields and even to towns by rapidly-moving areas of dunes. Many orchards and extensive tracts of rich agricultural lands have been wholly destroyed. At the great bend of the stream, near the Walla Walla River, there is a gorge, through which the wind sometimes blows with terrific violence, carrying before it sheets of sand. By this means a wide region has been converted into a veritable Sahara.

Much livestock has been destroyed by

these sand storms, which are described as among the most appalling of natural phenomena. Human beings caught in them have lost their lives on several occasions. The sand of these inland dunes is not like that of the dunes along the seacoast, which is always kept more or less damp by the moisture in the atmosphere. It is absolutely dry, and thus travels with much greater rapidity. Always, of course, it is wind that accomplishes the transportation of the moving hills, the process consisting in blowing the surface sand over from the windward to the leeward side of the dune.

By this continual transfer of its material the dune is made to crawl slowly but surely over the face of the landscape. Not the highest and strongest fences, nor any other obstacle that feeble man can erect, will successfully oppose its march. It may travel only a dozen feet in a year, but eventually it devours everything it comes across. In every region it is the habit of winds to prevail

THE SANDS COMPLETE THE RUIN.
Remains of a forest cut, burned over, and finally buried by sand.

from one direction in preference to others, and thus the march of the dunes, wherever they are found, is steadily onward, and not first one way and then another.

In the Columbia Valley the railroad has an immense amount of trouble to

A NEW KIND OF COAST DEFENSE.
A protected road through sand dunes.

keep the dunes from burying the tracks. Shovelers are kept busy all the time clearing them of sand, and every now and then traffic is brought to a stop for many hours, or even for days, by a sand storm. Such a storm may heap thoustands of tons of sand upon the rails—in which case, of course, there is nothing to be done but send a large force of men to the scene, to remove the obstruction. Even so, wrecks are caused every now and then by sand on the tracks. An accident of the kind, near the Dalles, in Oregon, half a dozen years ago, cost a number of lives.

One of the photographs presented herewith shows an expedient to which the railroad resorts in its more or less ineffectual fight against the dunes. This consists in a series of lightly-constructed fences, called "wattles," which are set slantwise on the advancing face of the sand hill. The fences do not obstruct the sand, but divert it, causing the wind to blow it upward and away.

It is only a very partial remedy, however. From time to time some new and ingenious device is tried, with more or less effect, but the dunes go marching on. At Riparia, on the Snake River division of the Oregon Railroad Company's line, large shops and other buildings have had to be moved, to prevent them from being covered by rapidly-drifting sand hills.

COURTESY OF FOREST SERVICE

WHERE THE SAND DRIFTS LIKE SNOW BEACH GRASS IS A USEFUL ALLY.

The source from which are derived the sands of the dune region of East Washington and the Columbia River Valley is more than ordinarily interesting. Scientific study has shown that they come from the bottom of an ancient inland lake, or sea, which, many millions of years ago, covered that part of the country. The Columbia flows through the bottom of this vanished lake, and during the annual period of high water, in June, large quantities of sand are carried into the stream and deposited on flats all along the Columbia, as far south as the Willamette River. Thus the supply of desert-making material is practically inexhaustible, and from year to year it is transforming a steadily increasing area into hopeless waste.

Along the shores of the Great Lakes, in many places, similar conditions, hardly less alarming, prevail. Dunes in such localities have already done enormous damage, and sand storms, which destroy extensive areas of fertile fields, are the dread of agriculturists. At Michigan City, Ind., the problem is more than ordinarily serious. The sands brought ashore by the waves, is blown by the wind off the beach, when dry, and piled up in a long dune which marches steadily toward the railroads—the latter running parallel with the shore, at a distance of only a few hundred yards.

There is no way to stop it. The only thing to do is to dig, and to keep on digging the sand away as fast as it threatens to overflow the railroads. When dug, it is carried away in cars. But the railroads in this instance manage to get even to a certain extent by selling the sand to brick-making concerns at Michigan City, which convert it into most excellent and useful sand bricks for building purposes. A large and always-accumulating surplus has found a

market at Gary, the model industrial town recently built by the United States Steel Company, where it has been used to fill in a great swamp.

Drifting dunes have done immense damage all along the Pacific coast, from the Columbia River southward to Golden Gate Park, in California. Likewise on Cape Cod, and in the southern half of Long Island. Where, on the seashore, the prevailing winds are from the water, the beach sands tend to form hills, which are transported continually further and further inland. Such hills may be from thirty to one hundred feet high, and sometimes they reach an elevation of two hundred feet.

The worst situation on the Atlantic coast is found on Cape Henry and Cape Hatteras, where the traveling dunes are covering valuable timber lands and swallowing up many houses. The life-saving stations maintained by the government in those localities have a hard fight for survival.

All along the coast of southern Virginia and North Carolina stretches, for scores of miles, a chain of immense dunes, which is slowly moving away from the shore and over the land, devouring everything in its path. Even the forts on the coast, though so formidable in defense against any human enemy, have suffered so much damage by invasion from sand, in some instances, that the War Department has been obliged to appeal to the scientific bureaus of the government, particularly the Forest Service, for means wherewith to protect themselves against this creeping foe.

In Europe the dune problem is a very old one. Within historic times, in that part of the world, drifting sand hills have buried numerous villages and extensive forests, checked the courses of rivers, and turned many fertile regions into deserts. Bordering the Bay of Biscay, in France, is a belt of dunes which covers 250,000 square miles. But Europe has found a solution for the problem in a certain species of tree, called the "shore pine" (*Pinus maritimus*), seedlings of which, when planted in the shifting sands, grow rapidly, and hold them per-

COURTESY OF FOREST SERVICE

GROWING PLANTS COMPEL THE WANDERING DUNES TO SETTLE DOWN.

WASHING AWAY A DUNE.
The sand is thrown into a swift stream and carried off through a flume.

COURTESY OF [illegible]

SAND FENCES TO KEEP THE RAILROAD TRACK FROM BEING FLOODED.

fectly. The "needles" fallen from the trees form a dense mat, which helps to hold the sand fast.

It will naturally be asked, Why should we not make use of the same expedient? The answer is that we have done so, but without success, simply because the shore pine, which flourishes in France and Spain, will not grow in this country. The Forest Service has planted it on sand dunes all the way from Virginia to Florida, but in vain. And, most unfortunately, we have no tree of our own that appears to serve the same purpose.

It often happens that a drifting dune, traveling inland from the shore, leaves between it and the beach line a bare space where grasses take root and trees later on grow up. The trees afford protection against the wind, and thus the sand hill, deprived of its motive power, so to speak, ceases to march. Grasses and other plants overgrow its surface, and it becomes stationary and permanent —transformed from a dangerous tramp, as it were, into a condition of harmless respectability.

Owing to this and various other causes, such stationary dunes are found in many places along the coast and inland. It is believed that anciently all dune areas at that time existing were covered with forest growth, and therefore possessed no inclination to travel. But this growth was destroyed, mainly through the instrumentality of fire, and consequently today, chiefly by reason of his own carelessness, man finds himself threatened by an enemy with which it is extremely difficult to deal.

COURTESY OF FOREST SERVICE

THE EVER-PRESENT THREAT OF THE SAND.

In some instances it is practicable to restrain and control the shifting sands by planting them with sand-binding grasses—such, for example, as the "marram," or common beach grass, which spreads rapidly by runners radiating out from its firmly-rooted bunches. The creeping roots, which attain a length of twenty to thirty feet, form a densely in-

COURTESY OF FOREST SERVICE

ORCHARD OVERWHELMED BY SAND.

terwoven mat beneath the surface, penetrating deeply, and knitting the sand together in a network of almost unbreakable fibers.

This serves to anchor the sand sufficiently to give an opportunity for the growth of the waxberry, which, once planted and made to thrive, affords adequate protection for certain shrubs—notably the red rose, which spreads almost as a vine over spots of bare sand. Virginia creeper, with its strong and woody stems, is next established on the dune, after which hardy trees may be planted, thus insuring its permanency.

Experience has shown that grass alone is not sufficient to accomplish the purpose. On the contrary, it actually helps in many instances to build dunes. Along many parts of the Atlantic coast are to be found sand hills, of the bigness of a house or thereabouts, which owe their development mainly to grass. As the grass grew, it offered something compact for the sand to accumulate upon, and thus the humble vegetation was a help rather than a hindrance to the sand hill.

Such a hill, however, is not a menace, but merely a useless disfigurement of the landscape. The traveling dunes are the kind that do the damage, and with the really active ones it seems to be impossible to deal effectively. Some means of fighting them must nevertheless be found, because the areas of waste created by these desert-makers are steadily increasing. As the lands along the Atlantic and Pacific coasts, and along the inland lakes and rivers, become more valuable, our government will find it necessary to pass laws and expend large sums of money for holding and planting the dunes, just as France, Germany, Holland, and Denmark have already been forced to do.

A dead dune, as distinguished from a "live" one, is simply a sand hill on which nature has succeeded in establishing vegetation. The problem is to find some means whereby the same thing can be accomplished artificially. At the present time, in places where the trouble is not very bad, a good deal is being done in this direction by planting sand-binding grasses—a kind of work which has been conducted on Cape Cod, in a more or less desultory manner, for more than a century. In early days the very existence of the village of Provincetown,

Mass., was threatened by sand storms, which were eventually done away with by the systematic setting out of beach grass—a local ordinance even allowing the authorities to go into a man's yard and plant the grass, if he would not attend to the matter himself.

The marram, or "sand reed," as it is sometimes called, is the conspicuous species of beach grass all the way along the Atlantic coast from New Hampshire to Maryland, its long-leaved stems growing in tufts from two to four feet high. For planting purposes, its creeping roots, which are really underground stems, are sometimes cut into joints, each of which will start a new plant. Wherever there are dunes, sand-binding grasses are to be found plentifully. Thus marram and "wild rye" are abundant along the shores of the Great Lakes. South of Maryland, on the shores of the Atlantic, the marram is replaced by "bitter panic" grass—so called because its leaves when chewed have a bitter taste. Further south occurs the "water oak," which bears large spikes of beautiful flowers.

When dry land begins to flow like water, trouble is likely to follow; and this is literally what happens in the case of the drifting dunes. Even out of the mischiefs of life, however, ingenious man often manages to make a profit in one way or another, and here is no exception to the rule. Not very many years have elapsed since it occurred to a shrewd Quaker to dig up the dune on the sea-front of his Long Island farm, load it on barges, and send it to New York for sale to building contractors. It is said that he got quite a little fortune out of it.

Immense quantities of sand are consumed in the making of concrete, mortar, and sand bricks. Whence it comes about that, at the present time, many areas of dunes in the vicinity of New York City, and especially on the south shore of Long Island, are proving veritable gold mines to their owners. They are worked with the aid of costly machinery, the material being dried, screened to free it from impurities, and carried by endless belts to waiting boats, into which it is dumped through hoppers. When a boat is loaded full, it casts off and starts for New York, delivering at the city dock its burden of sand in a perfectly clean and pure condition ready for use.

Disasters

Disasters come not singly
But as if they watched and waited,
Scanning one another's motions.
When the first descends, the others
Follow, follow, gathering flock-wise,
Round their victim sick and wounded—
First a shadow, then a sorrow,
Till the air is dark with anguish.

—LONGFELLOW.

PARK for BIGGEST SKYSCRAPER

By Bailey Millard.

LOOKING from a distance at any American city twenty years ago, one saw, looming above all the shops, factories and dwellings, those lofty monuments to piety, church spires, pointing the way to heaven. Today the tall towers of trade lift their dark bulks so high as to overshadow the proudest pinnacles of the church. Stand upon the Palisades near Fort Lee and look down the North River at New York and your eye will detect scarcely a trace of church architecture amid the bewildering mass of tall buildings. In the view from Jersey City, temples of worship are no longer visible.

Now in a city sky-line, steeple, minaret, dome, and tower effects have their values, and architects, fully realizing this, are adopting the idea. Ten or fifteen years ago tourists from Europe took one look at the sky-line of New York and said immediately and instinctively, "How ugly!" This was because the average flat-topped sky-scraper looked from a distance like a dry-goods box on end. It was utterly devoid of artistic effect, bare-looking, an offense to the esthetic eye. But today even the severe artist accepts the city silhouette and approves of it. For the architects of the tallest structures have provided pinnacles, domes, and even spires. Examples of these excellent effects are to be seen in the Metropolitan, the Singer, the City Investing, the Times, the World, the Tribune and other

THE WORLD'S TALLEST OFFICE BUILDING.
The Metropolitan Building, New York City, 700 feet high, soon to be superseded by the Equitable Building, which is to be over 900 feet high.

proud buildings of the metropolis of the Americas.

This idea is becoming general, so that there is now seen in New York, Chicago, and other cities a partial restoration of the inspiring effect of the sky-piercing steeple that was lost when the flat-topped, square-shaped sky-scraper rose above it.

Not only this, but as a further attempt at restoration, some of the tall city structures of today have been built on what may be called templesque designs. The City Investing Building of New York, with its pinnacle rising above pinnacle, and the new University Club Building of Chicago, with its pure Gothic plan, are among the better examples of this sort, and the tendency is a growing one. Then if to church architecture we add church bells, as the Metropolitan Life Insurance Company has done with its pealing chimes, we shall have still another feature to help along the analogy. For of course it is only analogy, after all, as in their interest and intent the towers of trade always will be one thing and the churches another.

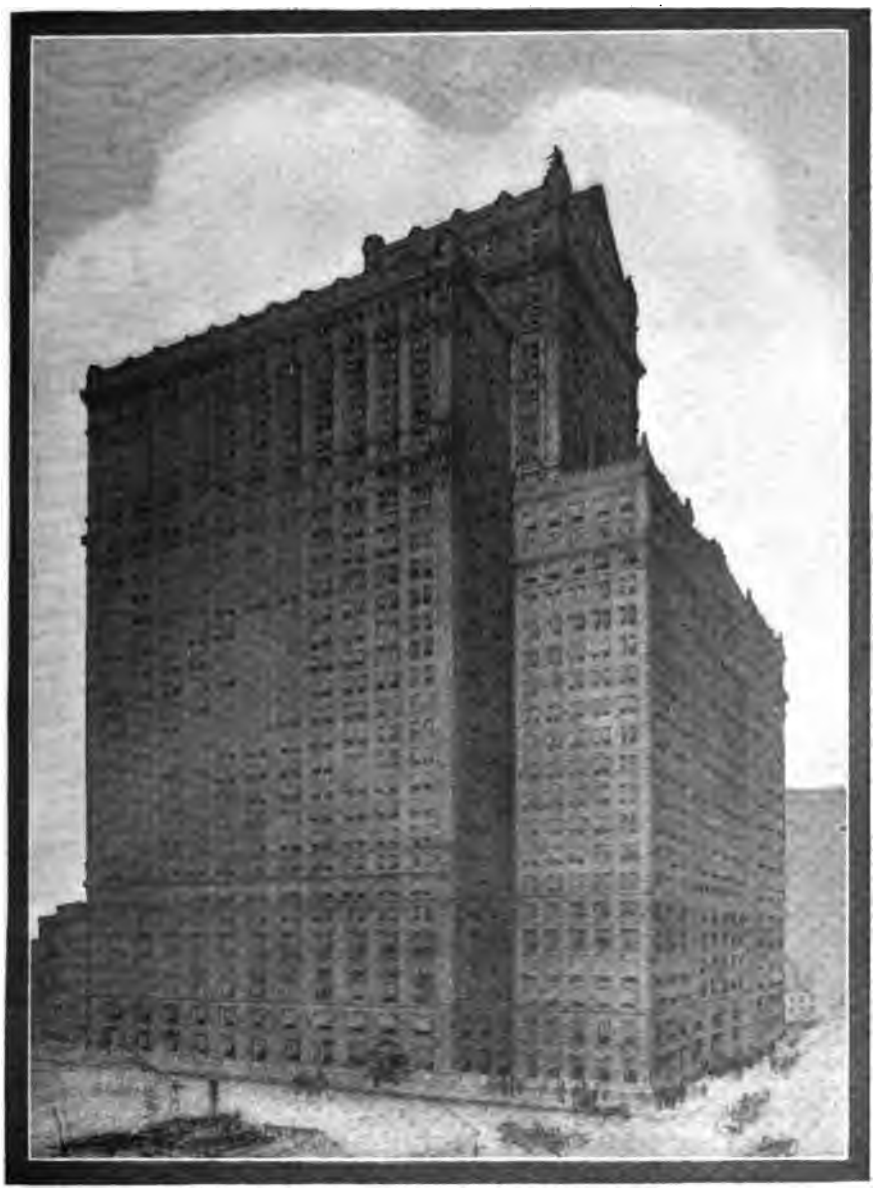
"I like a church," says Emerson; and so do most of us, even though we are not seen inside one as often as we might be. Perhaps it is for this reason, as well as the artistic one that, in these days of rampant materialism when men get up in the morning to buy and sell all day and then talk of buying and selling in the evening and dream of it all night, our people in their feeble relapses to the religion of their fathers, have gone back to church models for their architectural inspiration, thus giving substance if not soul to the maintenance of the traditions of the temple, which cling to the minds of men through the ages, despite the outward manifestation and open profession of a growing agnosticism.

Not consciously nor with avowed purpose did the builders of the tall temples of Mammon in this country set out to overshadow the churches, but merely to overtop each other. When the craze for aerial supremacy reached its top notch by the uplifting of the spindling, high-aspiring Metropolitan Building it was probably not thought of at the time that the hand that rounded St. Peter's dome

PARK ROW BUILDING.
A mere double chimney compared with the tremendous new Whitehall.

THE PRESENT WHITEHALL BUILDING.

was raised to a much less height than that which set the capstone upon the tallest structure in America. But such was the fact, for the seven hundred feet of sheer height from which the Metropolitan looks down upon Madison Square is two hundred and sixty-five feet nearer the clouds than St. Peter's itself, which from the ground to the top of the cross is only four hundred and thirty-five feet. The



THE PROPOSED WHITEHALL BUILDING.
On the right is shown the present structure with which it will be incorporated, forming the largest of all skyscrapers.

Singer, also, is higher than St. Peter's, rising six hundred and twelve feet from the sidewalk.

Londoners look up with awe and reverence to the spire of St. Paul's, piercing the sky to a height of four hundred and four feet, but there are five office buildings in New York that could look down upon it were they in range—the Metropolitan and the Singer, of which the heights have been given, the new Municipal Building, five hundred and sixty feet, the Times, four hundred and nineteen feet, and the Heidelberg, four hundred and ten feet.

The stately Duomo of Milan, to which generations of pious pilgrims have looked up with inspiration, is but three

NEW YORK CITY'S SKY
The structures built since then hide all

hundred and fifty-five feet high and would look low, even squat, beside the sky-scrapers of this country. For simple majesty of expression the facade of Notre Dame has no superior anywhere, but its height of only two hundred and sixty-five feet would seem insignificant beside any one of a score of our tallest sky-scrapers.

But if it is true that this lofty upbuilding of the temples of trade symbolizes a national consecration to commercialism, the humble spiritual mind is consoled by the thought that no matter though the churches be razed, as has been done in many instances in New York and other cities, and tall structures are reared on their sites in which men rave and sweat over the unholy task of money-grubbing, nothing can take the place of the religion that was once preached on that now desecrated ground, and the pious soul will follow that religion through eternity.

A distinctive feature of the old-time temple of worship was its churchyard, still retained in many cities, though the dead are no longer buried there. Would it be straining our analogy to the point of absurdity if it were suggested that in addition to pinnacles, spires, and chimes, the sky-scraper of the future would have its garden yard with ornamental shrubbery, trees and flowers? No, for the new Whitehall Building of New York, the largest of all sky-scrapers thus far proposed, is to have just such a garden.

As will be seen by the accompanying photograph of the drawings of this huge edifice, the builders of the Whitehall have not seen fit to adopt the more graceful upper lines of the Singer and the Metropolitan, but these buildings present their sheer facades to the street, while the Whitehall will look down upon Washington Street at Battery Place over an attractive little park, now wholly occupied by large structures that are to be torn down. The building will also have a frontage on West Street. The garden space will be one hundred and ten feet wide and two hundred feet deep, and will have lawns, trees, statuary, fountains, a pond, rustic seats and circling walks bordered by flowers and beautiful shrubbery. The details of the garden plan have not yet been worked out, but before the huge structure is complete they will be perfected by a landscape gardener who understands his business.

The new building will tower thirty-two stories above the sidewalk, with a total height of four hundred and sixteen feet. It will contain eleven million cubic feet and have a rentable area of five hundred and fifty thousand square feet. There will be thirty elevators, twenty-two locals to the twentieth floor and eight expresses stopping only above that floor.

It will be unnecessary to burden the mind of the reader with the exact number of millions of bricks, the barrels of cement, the tons of steel girders, the square feet of stone and tiles that will go to the making of this great structure, but they will be, indeed, prodigious. Some idea of the vastness of the building may be gained by the fact that it will conveniently house nearly four thousand people and over that many if a little

LINE FIVE YEARS AGO.
church spires shown in the photograph.

crowded, as most big office buildings are, and that to warm these people in cold weather will require over twenty miles of steam pipe.

The sky-scraper will have a frontage of three hundred and seven feet on Washington Street and one hundred and sixty-one on Battery Place. It will cover fifty-two thousand square feet or twenty-one city lots, and will cost eight million dollars.

Now about the park. It is not a dream, but a substantially planned business enterprise, based on the sound commercial judgment of its projectors, a great real estate company, the leading spirit of which is William Cheseborough, who in 1903 built the original Whitehall Building, a twenty-story structure facing the Battery, which will be made a part of the new building, thus giving the Whitehall people, on its completion January 1, 1911, the largest single office building in the world.

Several old buildings, some of which would have been considered proud structures fifteen years ago, are now being demolished to give place to the new structure and the park which it is to overlook. Real estate is valued at wonderful figures in New York today. Land not far from the Whitehall has sold recently as high as five hundred dollars a square foot. The space to be devoted to the park is valued at over half a million.

"How can you afford to devote this immensely valuable plot to a mere pleasure ground?" I asked one of its projectors.

"Because it will pay," he replied. "The project is fully justified by our experience with the present Whitehall Building, which is one of the most popular and successful office structures in New York for the reason that it overlooks Battery Park. We saw how our tenants liked sunlight and air and a glimpse of green trees and a green lawn, and we came to the conclusion that the new building would be a better investment if it also had those advantages. The idea was natural enough, as many of our present tenants have found themselves crowded for room and have applied to us for more, saying at the same time that they would hate to give up the view from their office windows. But they will have just as good a view when they look out upon the new park. Of course the time may come when we shall have to build upon the park area, but that, we hope, will be remote. In fact if the park project pays as well as we think it will, we shall never build upon it."

So, while, as it will be seen, the considerations are not wholly esthetic ones, the tenants and the public generally will come in for a big benefit.

How did the Whitehall Building get its name? For the answer to that question we shall have to go away back to 1643, when Peter Stuyvesant was made director-general of the Dutch West India Company and came to New Amsterdam with big ideas of public improvement. He built a house on what was afterward called Bowling Green—a wonderful house for those days, which was called White Hall, and in it he ruled for a long time—ruled so harshly in fact that when in 1653 a delegation of

THE TIMES BUILDING.
Merely a spindling tower if contrasted with the new Whitehall.

colonists came to him with demands for a confirming voice in the matter of local appointments he stood on the steps of White Hall and raising his voice very loudly, commanded them to disperse forthwith, declaring that his authority

was not from the people but from God and—the Dutch West India Company.

So this site on the old Bowling Green, the precise spot on which the biggest office building in the world is to stand, has a historical if not romantic interest. Over a hundred years later the old White Hall was torn down and work was begun under the direction of Washington for a building in its place that was to be the national capitol. But when completed the structure was not occupied for that purpose, as the capital was removed to Philadelphia.

When one looks at a photograph of the present Whitehall Building superimposed upon the plan of the new one on the same scale, the former, though an immense building three hundred feet high, presents a pigmy aspect, as the new structure will be more than four times as large and will rise to a height of four hundred and fifty feet, or, to get back to our churches, forty-six feet higher than proud old St. Paul's of London.

It must make the spirit of old Peter Stuyvesant give a smile of satisfaction to know, if spirits do know such things, that the site he selected as the best on Manhattan Island should be occupied by the largest office building in the world. And how proud Peter will be when he looks upon his statute in Whitehall Park!

At present the largest office building in New York is the Metropolitan, which boasts of a floor area of thirty-six acres. This claim is disputed by the builders of the Hudson Terminal, which, however, consists of two complete buildings with a main thoroughfare between them. As neither one of the two approximates to the Metropolitan in size it may justly be said that the latter is by far the larger. The Singer, forty-seven stories, and the Metropolitan, fifty stories, will continue to be the tallest office structures, but they will be mere chimneys in contrast with the huge bulk of the Whitehall.

As to the tearing down of large buildings to make room for still larger ones as is being done on the Whitehall site, that peculiar sort of waste is going on in New York in a manner undreamed of in the old European cities. Every week some proud structure begins to go down to its ruin before the hands of the destroyers, and on some of the down-town office sites house after house has been demolished, upbuilt and demolished again. The most remarkable example of this sort of thing is seen in the case of the Gillender Building on Wall and Nassau streets, where about the year 1820 James Walker erected a two-story building which was torn down in 1843, when the Union Building, eight stories high, the first "tall" office structure in New York, was erected on its site. Jay Gould had his offices there until 1873, and before it was taken apart and thrown into the scrapheap in 1897 Charles W. Morse, the former "Ice King," occupied one of its floors. Then the present Gillender Building, sixteen stories high, was erected on the same ground at a cost of half a million. And now it is planned by the Manhattan Trust Company, which owns the Gillender, to throw it out of the way and build in its stead a thirty-two story building that shall loom proudly over Wall Street.

This is deemed to be a profitable business move as the land is valued at one million dollars or six hundred and fifty-five dollars a square foot, for which it was sold in January of this year by Mrs. Helena L. Gillender Asinari to the Manhattan Trust Company. This price, of course, includes the present building, but as that is to come down, it must represent, therefore, merely the value of the land.

Since the earthquake and fire in San Francisco some remarkable sky-scrapers have been built in that city. Probably the most artistic there is the Humboldt Building, which is of steel and intended to withstand both flame and shock. It is a handsome structure of twenty stories, dome-topped and imposing. Many new sky-scrapers of the rehabilitated city are of reinforced concrete, which stands a very hard shaking. The Whittell Building, sheathed with armor-plate, is another of San Francisco's proudest structures.

Chicago's architects are well to the fore in the matter of ideas for the relief of the city sky-line, and though this is not the primary result sought for as each designer simply works to perfect the plan in an individual case, the result cannot fail to aid in beautifying the city. The University Club Building which has many admirers, will be followed by many

other tall structures of like artistic value. In Kansas City, where many proud office buildings have been erected of late years, a similar tendency is noted.

In New York, where down-town plots have sold of late years at such enormous prices it will seem to many persons, despite the declarations of the Whitehall people to the contrary, that it is a sheer waste of money to make and preserve such a large open space as is proposed; but these men know what they are doing. Just as it has been discovered after years of fighting between architects and owners that really artistic buildings of any sort from cottages to sky-scrapers, actually pay, so will it soon be discovered that the park area for the tall structure is a good investment. An office building with such a park or garden is naturally far more attractive to tenants, who in many cases will be willing to pay higher rents than they would for the privilege of looking out upon a dull, dreary brick perspective.

Let us have more of these parked office buildings and more and more domes, towers, turrets and pinnacles upon them, and in time the dullness and ugliness of our cities will vanish.

The Shepherdess

She walks — the lady of my delight —
A shepherdess of sheep.
Her flocks are thoughts. She keeps them white;
She guards them from the steep.
She feeds them on the fragrant height,
And folds them in for sleep.

She roams maternal hills and bright,
Dark valleys safe and deep.
Into her tender breast at night
The chastest stars may peep.
She walks — the lady of my delight —
A shepherdess of sheep.

She holds her little thoughts in sight,
Though gay they run and leap.
She is so circumspect and right;
She has her soul to keep.
She walks — the lady of my delight —
A shepherdess of sheep.

— Alice Meynell.

NEW HOME FOR THE BRITISH FLEET

By HAROLD J. SHEPSTONE

THE new harbor recently completed at Dover, England, by the British Admiralty, which was formally opened by the Prince of Wales, is, without question, one of the greatest engineering feats ever put in hand and brought to a successful completion. Indeed, this new home for the British fleet can claim the distinction of being the largest artificial harbor in the world. It encloses at low tide a water area of no less than six hundred and ten acres, affording ample accommodation for a fleet of twenty-five first-class battleships with the attendant smaller craft, such as torpedo-boats, gunboats, etc. This giant of harbors has taken eleven years to construct and has cost the government $20,000,000.

By the erection of this giant refuge for the British fleet, the ancient English port of Dover has been transformed at a stroke into a powerful naval base. The reason for this transformation is not far to seek. It is the policy of the British Admiralty for the strength and bulk of their ships to lie nearest their strongest rival. That rival today is Germany, hence the desirability of equipping Dover with an efficiently-protected harbor, where the ships can lie safely at anchor and yet be in a position to strike quickly at the North Sea. As a matter of fact, other naval bases are being erected on the east coast of Great Britain. One is now nearing completion at Rosyth, in Scotland, and another new harbor is to be constructed in the Orkneys.

There is no port that has figured so conspicuously in the history of the Brit-

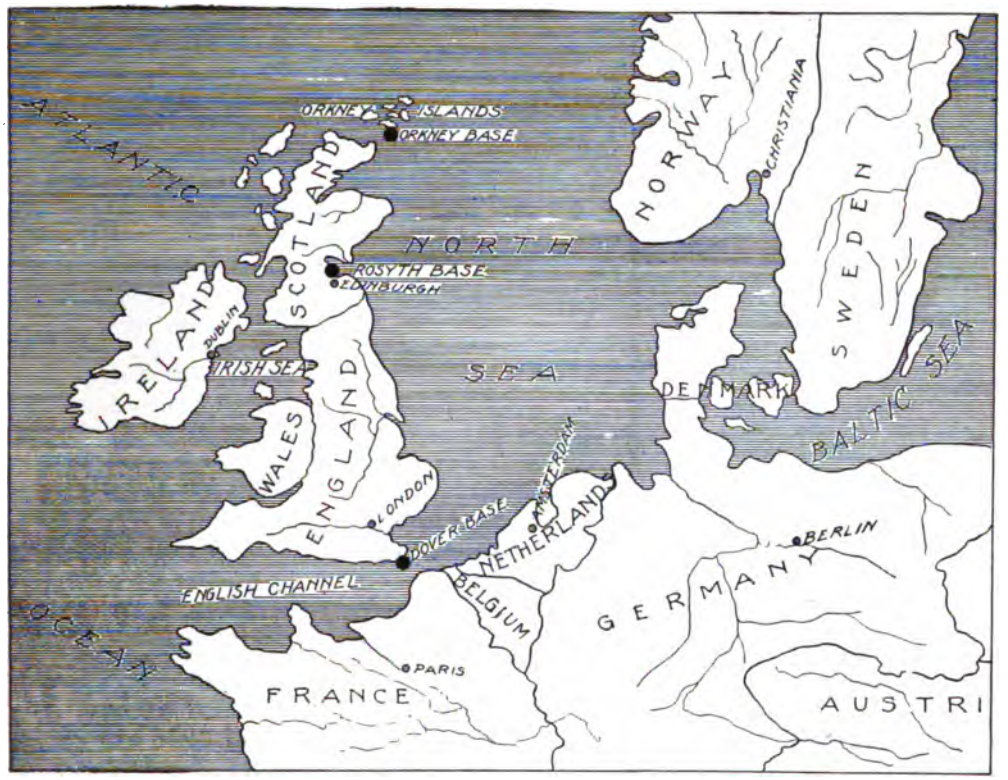
BUILDING THE NEW HARBOR AT DOVER, ENGLAND.
This is the largest artificial harbor in the world.

THE BREAKWATER AT DOVER BEGINNING TO TAKE FORM.

ish nation as Dover. In the days of Queen Elizabeth Sir Walter Raleigh called attention to the unique position of Dover, declaring that "no promontory, town, or haven in Christendom is so placed by nature and situation, both to gratify friends and annoy enemies, as this town of Dover. . . . Nor is there in the whole circuit of this famous isle any port, either in respect of security or of defence, or of traffic or intercourse, or rather necessity, to be regarded than this town of Dover." After reading this epistle, Queen Elizabeth, we are told, with commendable enterprise, decided to restore and improve the harbor. The channel, which had previously been only four feet deep, was extensively dredged and deepened. James I. also effected some improvements, and so things went on until the middle of the eighties, when a Royal Commission was appointed to inquire into the state of the port.

It was not until the beginning of 1898 that plans were finally approved for the erection of the present harbor, and in the summer of that year, the work was put in hand. The new harbor has been obtained by the erection of three arms or walls. The Admiralty Pier, so familiar to all who have crossed the English Channel by the Dover-Calais route, and which had a length of one thousand feet, has been lengthened another two thousand feet and forms the western arm of

A GENERAL VIEW OF THE BREAKWATER WHEN NEARING COMPLETION.



ENGLAND'S THREE NEW NAVAL BASES.
They are situated, respectively, at Dover, near Edinburgh, and in the Orkney Islands.

the harbor. From the base of the tall cliffs, immediately below the old convict prison, to the east and the town, a wall three thousand three hundred and twenty feet in length, and known as the east arm, was built. The third wall is the southern break-water, four thousand two hundred feet in length, and situated some three-quarters of a mile from the shore and almost parallel with it.

One of the first things the builders did was to reclaim twenty-one acres of land to the east of the town. This was done by erecting a sea-wall, thirty feet high and three thousand eight hundred and fifty feet long, the space between this and the shore being filled in with chalk and rubble obtained on the spot by blasting away the cliffs. Only small charges of dynamite were used, so as not to shake the adjacent buildings. This was a tedious undertaking, over six hundred thousand cubic yards of excavations being required to fill the huge gap. The work naturally took some time, and at one period of this inception two thousand men were at work upon it.

The moment the new land was obtained it was at once turned into a block-yard. Here the concrete blocks of which the harbor walls are built, were made. These blocks, of course, were composed of cement, shingle, and sand, mixed in certain proportions. This was done by electric mixers which ran up and down the yard on elevated platforms mixing the material as they traveled to and fro. The mixers then poured their contents into waiting moulds. After two days the sides of the moulds were removed and the block conveyed to the end of the yard, where it remained for another six weeks, when it was quite ready for the builders. These blocks measured fourteen feet three inches long, five feet six inches wide, and six feet deep and weighed forty-two tons. The smallest blocks used turned the scale at twenty-

THE LIGHTHOUSE THAT ILLUMINATES THE WAY FOR THE NAVAL DEFENDERS.

four tons. To facilitate the removal of such an unwieldy mass, each block was "cored" with two holes.

Before these blocks could be laid on the ocean bottom, it was necessary to erect in the sea temporary staging to carry cranes and a host of other heavy machinery. This staging was very massive, and stood far above high-water mark, and measured one hundred feet from top to bottom, being in fact, higher than an eight-story building. The piles which carried this working platform measured one hundred feet in length. At first the contractors used Oregon piles, but as it was necessary for them to weight this wood with iron, so that it would sink should it become loose, and not become a menace to shipping, it was consequently supplemented by Tasmanian blue gum piles. This timber is one of the heaviest of woods. Its density is such that it will sink like a stone. These one hundred-foot piles weighed no less than ten tons. At intervals of every fifty feet two sets of six piles were driven firmly into the ocean bed opposite one another. Across the piers thus formed, strong iron girders were placed, and in this way the temporary wooden staging was gradually built out seawards. Although this work was purely temporary, it had to stand the full force of the storms and tidal currents, as well as to carry hundreds of tons of machinery. Some of the Goliath cranes upon it weighed four hundred tons apiece. They had a lifting capacity of sixty tons on a one hundred-foot span.

In the sea between these piers, the blocks that form the permanent walls were laid. Before this could be done, however, it was necessary to secure the foundations. First of all a giant grab, a jawlike contrivance with a double row of formidable teeth, descended to the bottom of the sea with open mouth. There it worked its way into the chalky bed, fastened its teeth into it and came up with a dripping mouthful of flint and chalk that filled a railway truck. By this means the upper crust was eaten away, until the solid bed was reached. Divers were then sent down in bells, whose duty it was to level the bed ready to receive the blocks. In all, some seven bells were used, the largest ever made. They measured seventeen feet long and ten feet wide, and turned the scale at thirty-five tons. The writer took a trip down in one of these bells on the east arm and it was certainly a novel experience. Four men worked in a bell, under a pressure of twenty-seven pounds to the square inch, for three hours at a stretch. The huge chamber was as bright as day, being illuminated by electric lights. It was amusing to watch the fish dart at the windows in the corners of the bell, attracted by the light. When the bells touched the bottom there

was, perhaps, two feet of water in them. This was quickly driven out by an extra pressure of air. Occasionally the receding water left straggling fishes behind. On more than one occasion fierce conger eels were caught in this way. One bell made a rapid ascent to the surface while working on the breakwater, and with scared faces the men told how they had landed on a sea serpent or some submarine monster. The foreman decided to investigate. He descended, and his amusement may be imagined when it was found that the trouble had been caused by an innocent pair of bullock horns protruding from the sand.

As the great blocks were lowered from the powerful cranes into the water they were guided and placed in position by dress divers, who worked, of course, from small boats. For years the diving staff totaled over eighty men, the greatest number of divers ever employed on a single undertaking. Among the divers not a single fatality occurred, a commendable fact considering the magnitude of the task. At the same time the men have known what it is to contend with strong currents and fierce storms and winds. For days together they have been unable to proceed with their task. During a severe gale which swept the Channel in the September of 1903, a portion of a temporary viaduct, with giant cranes upon it, was washed away. Often divers had to descend in very rough seas to lash spars and piles and machinery to prevent them from getting loose, and they experienced other difficulties and generally exciting adventures, which, while adding to the hardships, also increased the interest in the work.

So accurately were the blocks laid at Dover, that when the walls appeared above the surface, they were even and regular. The blocks below the water level are not cemented in the ordinary way. To prevent the possibility of any slight lateral movement under the shock of heavy storm waves, the blocks are "joggled." In other words, cylindrical cavities are left between the blocks, and these are filled in with concrete in bags, thus consolidating the mass, and virtually making the walls in one solid piece. Above low water level the blocks are faced with thick concrete slabs, but this is not needed under water. The harbor side of the wall is perpendicular, but on

THE GREAT HARBOR AND ITS BATTLE FLEET.
Where England's warships are within easy striking distance of the German coast.

the seaward side each course up is built in steps. We get an idea of the massiveness of these walls when it is stated that the east arm has a width at the bottom of fifty-four feet, and is forty-seven feet wide at the top. The southern breakwater is a few feet wider. Some sixty-six thousand large blocks averaging about thirty-five tons each in weight, two hundred thousand tons of granite and 2,500,000 tons of concrete were requisitioned for building the walls of this harbor of refuge. In addition to this new home for the British fleet the builders are erecting a harbor for commercial ships which with an area, at low tide, of seventy-five acres will offer very ample harbor facilities.

Lead, Kindly Light

Lead, kindly Light amid the encircling gloom,
Lead Thou me on!
The night is dark, and I am far from home,
Lead Thou me on!
Keep Thou my feet! I do not ask to see
The distant scene; one step enough for me.

I was not ever thus, nor prayed that Thou
Should'st lead me on;
I loved to choose and see my path; but now
Lead Thou me on!
I loved the garish day; and spite of fears,
Pride ruled my will; remember not past years.

So long Thy power has blest me, sure it still
Will lead me on.
O'er moor and fen, o'er crag and torrent, till
The night is gone;
And with the morn those angel faces smile,
Which I have loved long since, and lost awhile.

—CARDINAL NEWMAN.

LOUIS PAULHAN WITH MRS. "DICK" FERRIS FOR PASSENGER.
In this Farman biplane Paulhan made his extraordinary high flight record at Los Angeles.

LATEST SUCCESSES IN FLIGHT

By CHARLTON LAWRENCE EDHOLM

FOR us of the West the wonder of flying is over and done with. We have accepted it as a fact, seen with our own eyes, that man can fly. And we ask ourselves, like true children of the new century, "Why *shouldn't* we fly?" It all seems such a matter of course that man, who has mastered the earth and the treasure-bearing secret places under the earth, the sea, and the deeps thereof, should also be master of the air.

I think that the unconcerned manner of the aviators has something to do with our feeling that flying is no longer a modern miracle, but just a new and convenient way of getting from place to place. They do not look like miracle-workers, these men; the modest, affable little Frenchman, Louis Paulhan; the keen-eyed taciturn Curtiss, a typical American business man, that; the boyish Willard, and Hamilton who appears no less a boy, though of a quieter type; these masters of the air do not impress you as wonder-workers but rather as men like ourselves, who have merely learned to use a new tool.

Yet they all hold records, some of them new-made in Los Angeles. Paulhan has to his credit the official altitude of 4,165 feet and a cross-country flight of forty-five miles, both world records and both newly won. Curtiss is the speed king and showed us what he could do by covering the course of 1.61 miles in two minutes and twelve seconds. Hamilton proved his iron nerve when he made the long distance glide record, dropping 250 feet, with a broken engine, and landing safely and easily. That was his Los Angeles feat, and was done because he either had to glide or break his neck, as the crank shaft of his motor broke while he was trying for altitude, and it was a case of glide gracefully or drop to death. Since then he has bettered his record in San Diego by deliberately cutting off his

engine at an altitude of 500 feet. Charlie Willard demonstrated that he had absolute control of his bi-plane by taking flight from a square in front of the grand stand, a square which measured only twenty feet, but into which he dropped again after circling the course; a record for skill which is unsurpassed.

These are only a few of the events of those ten days at Dominguez, which have so thoroughly upset our old-fashioned ideas of the laws of gravity. That, be it noted, is the really *big* event. We went to the field, thousands and thousands of us, crawling caterpillars, you might say, and returned—no, not butterflies, but developing creatures who feel their wings, although they have not yet made use of them. We all of us know, the thousands and thousands of us, that some day we too shall fly.

The Aviation Meet—or, as we say out West, the First Annual Aviation Meet—took place on the gently rising ground of the old Dominguez Rancho, one of the historic points of southern California. It was the scene of a skirmish in the Mexican war with General Frémont in command of the American forces. The ancient landmark, an adobe ranch house, with its roof fallen in and its windows washed out, stands near the car tracks at the gate. The new ranch house, a typical Spanish-American home, is near by. Its many broad arches uphold a roof of red tiles such as the early Californians used. There we have it, the old and the new side by side; the adobe ranch house which sheltered a race, hospitable, leisurely and pleasure-loving; and beside it, the field where a breed of eager conquerors rejoice in the conquest of a virgin domain.

The grand stand was built in a position which made the aviation field a wonderful panorama, for the background was the snow covered ranges of the Sierra Madre and the San Gabriel mountains rising above the cities at their feet. Thus the spectators saw the air craft in flight with a background of rare beauty. The aviators sped across a sky of clear

blue, the typical January sky of southern California, and above them were white summery clouds, while below them were peak after jagged peak, and the green, fertile fields of the lowlands. It is these climatic conditions which make it almost certain that an annual aviation meet will be held in Los Angeles in the winter months. And there is hardly any doubt that in the next meet some of the local inventors will make successful flights, for there are many enthusiasts in the Southwest who are working on original plans. A few of them entered their aeroplanes this year but not one of them succeeded in getting off the ground. The Western inventors have been greatly hampered by lack of motors; some of them trying out their machines as gliders, and others simply putting their theories into shape and waiting for the chance to equip their devices with power. Others tried to make use of automobile engines, but without success.

One of the pluckiest features of the meet, however, was the action of a Los Angeles boy, Edgar Smith, whose scalp was laid open by the revolving propeller of his monoplane. The blow was so vicious that he was carried off the field for dead, and the iron blade of the propeller was crumpled like pasteboard where it struck his skull. But in five days that nervy young Westerner was on the field again, his scalp not yet healed over, cranking up his engine and attempting to fly. It is fellows of that gritty sort who win out in the long run, and I have no doubt that we shall hear more of Edgar Smith some of these days.

Several totally different principles in airship construction were developed by local men. Professor Zerbe's multiplane was the most striking of these innovations. It had no less than five pairs of wings, set one above the other and running back at an angle of about forty-five degrees. It was a very heavy, unwieldy vehicle and failed to leave the earth during the meet.

Another interesting experiment is the "disappearing wing tip" of the Skoglund monoplane. These wing tips are constructed somewhat like roller shades but are controlled by a lever. As one lengthens, the other shortens and in that way

GETTING READY FOR A START.

the balance of the air craft may be maintained, or at least, that is the inventor's theory.

One of the few accidents of the meet was the wreck of the Gill-Dash bi-plane, modeled closely after the Curtiss machine. It was driven about the course by a novice in what appeared to be a successful flight, but in alighting the left plane struck heavily against the ground and was badly broken. One of the Bleriot monoplanes came to grief in the same way, but in neither case was the aviator injured.

The Bleriot type was the object of the greatest curiosity on account of its spectacular feat in crossing the English Channel, but it proved a disappointment at Los Angeles. The two machines of that model were flown, it is true, but only on two days of the meet, and then for short and rather unconvincing flights. The construction of this type is entirely different from the bi-plane not only in the use of one pair of wings instead of two, but also in the position of its engine, a three-cylinder Gnome, which is set in front of the beetle-like wings. The aviator's place in the Bleriot is above the planes and behind the engine, while in the Farman and Curtiss machines it is between the upper and lower planes. This, of course, lowers the center of gravity, and makes for safety in flight.

The engine of the Farman bi-plane used by Paulhan is one of the beauties of mechanical art. It is a 50 horse-power seven-cylinder Gnome. The cylinders are set like the spokes of a wheel and the whole engine revolves with the propeller, thus acting as its own fly-wheel and giving perfect steadiness to its motion.

DIRIGIBLE BALLOONS STRAINING FOR FREEDOM.

The Curtiss makes use of an eight-cylinder engine of the same power but it is not of the rotary type. The lighter weight of Curtiss's machine may account for his swifter flight. There is hardly any doubt that Paulhan's splendid engine is responsible for his successful long-distance and altitude flights.

One of the interesting events of the meet was the "bomb throwing" from an aeroplane. Lieut. Paul Beck, U. S. A., ascended

THE GILL-DASH BIPLANE—A MACHINE THAT CAME DOWN IN A WRECK.

FLYING CLOSE TO THE EARTH.

with Paulhan and endeavored to drop imitation bombs into a square of about twelve feet. The bi-plane sailed around the course, allowing the officer to toss these bombs from a height of a hundred feet or thereabouts, but none of them quite reached the mark. The aeroplane did not sail directly over the target but was about twenty feet to one side, so that it was not quite a fair test. On the other hand, the aircraft was flying so low that it would have been an easy mark for sharpshooters. It remains to be demonstrated, therefore, what accuracy could be developed in dropping missiles from any safe altitude.

If the local aeronauts failed to make good with the heavier-than-air craft, they were thoroughly successful with the dirigible balloon. Roy Knabenshue and Lincoln Beachy operated two dirigibles with perfect ease, beating against the wind, turning within their own length and disporting themselves in the air like a couple of big fish in an aquarium. These cigar-shaped balloons are given to plunging and pitching like a small boat on the waves and the operator balances his craft by throwing the weight of his body backward or forward, or even moving along the trestle which he straddles. The race around the course by these dirigibles was rather picturesque. They reared and strained against the wind at the most dangerous angles, did everything, in fact, but buck, at the same time keeping neck and neck on the aerial track. Just before reaching the grand stand, however, Beachy let out his engine and passed the line first, making the course in four minutes and fifty-seven and four-fifths seconds.

The closing day was marked by two interesting features, one of them a race between the two greatest aviators of the meet, Glenn Curtiss and Louis Paulhan. The latter was trying for endurance and had made several laps before Curtiss had his engine tuned up. Abruptly the American left the ground and sped after Paulhan at a terrific speed. It was not an out-and-out race for speed, but there is hardly any doubt that the Frenchman would have kept the lead if he had been able, but such a pace as Glenn Curtiss sets is too much for even Paulhan, and the American passed him in mid air while a wild chorus of cheers shook the grand stand. Again they circled the course and once more, this time right in front of the crowd, the American whizzed by his rival, leaving us with the happy feeling that the honors had not all gone to a foreigner, even one so popular as Louis Paulhan.

The aerial parade which also took

GLENN CURTISS IN A SPEED TEST.

AN UNUSUAL TYPE OF FLIER—J. S. ZERBE'S MULTIPLANE.
It refused, however, to leave the earth.

place on the last day of the meet was absolutely unique. It showed the progress man has made since the days of Adam, when he walked on two feet, as the band-men walked in this remarkable procession. After the pedestrians came the horsemen, then the ox cart driven by Ezra Meeker, an old man who had made the trip across the continent by the Oregon Trail in the early days and retraced his path just a few years ago in the same kind of vehicle. Then came the modern buggy, the bicycles, from the old "high wheeler" to the present day "motor-bike."

ALL READY TO ASCEND.

Then the automobile, and the old-fashioned spherical gas bag. This was a captive balloon used by a local newspaper for obtaining photographs. After that came the dirigibles and the various types of heavier-than-air machines, among them the ones which hold the world's record for speed, long-distance and altitude flights. Although they were not in line, the electric cars and railway trains were visible from the grand stand, and thus we had a wonderful summing up of man's progress for getting about the world.

Perhaps the most wonderful thought of all is that up to a few generations ago, in the time of Jefferson, say, the horse set the pace for rapid travel. All these inventions which have made the whole world neighbors and which may soon erase all boundary lines that earth-bound humanity has traced, all these are the products of our own restless age, whose ambitions soar even to the skies.

PAULHAN LEAVING THE GROUND WITH A PASSENGER.

The Hut By the River's Side

That dear old hut by the river's side
With the warmest pulse of my heart is allied,
And a glory is over its dark walls thrown
That statelier fabrics have never known;
And I shall still love, with a fonder pride,
That little old hut by the river's side.

—B. P. SHILLABER.

DOOM of the GIPSY MOTH

By William Thornton Prosser

A GALE of wind often blows down houses, wrecks property, wreaks general havoc, but the extent of the damage is usually apparent the next day. This is preliminary to telling the story of a windstorm that visited the vicinity of Boston about forty years ago, and which was an exception to the rule. This gale was scarcely remarked at the time—perhaps a few chicken coops suffered—and was forgotten as soon as it ceased—forgotten by all but one man. Yet that wind left a curse that did not develop for a score of years. The baleful effect of this curse has extended through Massachusetts and into her sister states, each year reaching more serious proportions. It has cost hundreds of thousands of dollars in efforts to suppress it, while the damage it has wrought reaches into the millions. And more fortunes will be needed before the curse is checked, but for the first time an effective method has been found of combating this curse that the windstorm left.

Prof. Leopold Trouvelot, of the astronomical observatory at Harvard University, was interested in the silkworm. He thought possible that a hardier breed of the insect could be produced, and was experimenting along that line. Disease was attacking the commercial silkworm, both in the United States and in Europe. Professor Trouvelot imported silk-spinning caterpillars, in various stages of development, and among them were clusters of eggs from the gipsy moth. In the village of Medford he conducted his experiments, placing the caterpillars on a shrub in his yard. To keep the specimens from becoming scattered he covered the bush with a net.

The New England states would today be free from the terrible gipsy moth curse if that windstorm hadn't come along and torn the net asunder, liberating the caterpillars and moths and scattering them beyond recall. It is not always easy to trace the origin of such pests, but the gipsy moth's introduction is clearly established. The Harvard professor strove hard to discover and exterminate the scattered specimens that he had brought across the Atlantic, and for a time thought he had succeeded, but the years tell the story of his failure. It was 1889, however, before the moth became a recognized pest in Massachusetts, and efforts were made to stamp it out. The moth is likened to the

DR. H. LOOMIS.
Discoverer of the parasite that kills the gipsy moth.

THE OLD METHOD OF DESTRUCTION.
Burning gipsy moth clusters off stone fences.

locust, that sweeps everything before it. In its caterpillar state the moth does most damage. It eats everything in its path—fruit, shade trees, almost every sort of vegetation, entire forests. Its ravages in the vicinity of Boston so alarmed the people that after several years they obtained an appropriation of $200,000 a year from the state legislature. An army of men went forth to slaughter the pest. Fire, acids, poisonous substances of all sorts were used to stay the ravages of the voracious caterpillar. Under the direction of a commission the work was carried forward systematically and earnestly.

Then in 1899 the legislature thought that the damage of the moth had been exaggerated, and declined to sanction the use of more of the state's money in the campaign. Until 1905 the scourge was left to itself again, save for local work in the different towns and counties particularly afflicted.

In the five years the moth had such an opportunity to spread that when the state fight began again it had infested an area many times as great as that attacked up

Outdoor Laboratory, Near Boston, for Breeding Parasites of the Gipsy Moth.

BREEDING PARASITES OF THE GIPSY MOTH.

AN OUT-OF-DOORS BREEDER.

HOW THE INSECTS ARE MAILED.
They crawl into the glass tubes to seek the light. These tubes are then detached, packed, and mailed to where needed.

to 1900, and today the moth is found as far to the northward as Bar Harbor, Maine, in New Hampshire, Rhode Island and Connecticut. The original area of 359 square miles had grown to 2,224.

The infected districts appealed to Congress for assistance in addition to a small appropriation that had been made to aid scientific research, and the Fifty-ninth Congress appropriated $82,500 to be expended under the direction of the Secretary of Agriculture. The towns and counties renewed their efforts. Newton, Mass., in 1909 has spent not less than $200,000, secured locally and through the state. This report of conditions at Newton gives an idea of the seriousness of the situation:

"In July, 1908, there was scarcely a single street that had not been affected more or less seriously by the ravages of moths or beetles. The moths had riddled the trees of Chestnut Hill as if with fine shot, and here and there the branches had been stripped bare. Commonwealth Avenue had been left in a deplorable condition. The caterpillars had destroyed the leafage on tree after tree. Some sections looked as if they had been blighted by the breath of winter. The beautiful woodlands on each side of Lowell Avenue had been almost defoliated. Both sides of Dudley Road gave evidences of the devastating power of the gipsy moth.

THE GIPSY MOTH AND ITS CATERPILLAR.

"How many thousands of caterpillars and egg clusters have been destroyed cannot be told, even approximately, but creosote has been applied to every tree along the public highways and on hundreds of private grounds. This was followed with a thorough spraying with arsenate

of lead. In the course of two months 300,000 gallons of this powerful antidote was showered on the trees. In numerous instances an early spraying saved splendid trees that had previously undergone two strippings of their leafage. Another defoliation would have meant the death of the tree.

"The work in the beginning consisted in destroying all the egg clusters and moths that could be discovered. Each cluster contained from 300 to 500 pros-

BEETLE ATTACKING GIPSY MOTH CATERPILLAR.

pective caterpillars. To discover them was a difficult and tedious task, for the pest propagates in all sorts of nooks and crannies, but to each cluster was applied a dose of creosote, and grove after grove and wood after wood were stripped of the underbrush, which forms a favorite place of concealment for the noxious pests.

"In addition, every tree has been burlapped, burlap around the trunks forming an excellent place for the caterpillars to gather, especially at night. On Commonwealth Avenue 5,000 trees were thus protected from the pest. The trees on 350 private grounds were also cleared of egg-clusters, sprayed and burlapped. By a city ordinance the work is made complete and effective by giving to the official gipsy moth fighters in any locality permission to enter any grounds which may be affected and might prove breeding places. This power is absolute. The cost of this inspection and treatment is added to the owner's tax levy."

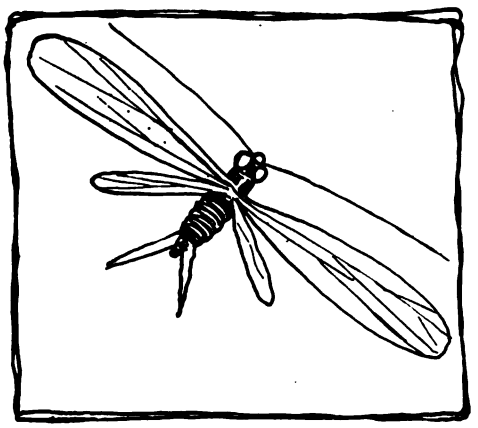
THIS BEETLE IS IMPORTED TO ATTACK THE GIPSY MOTH.

Thus it will be seen how seriously the people of Massachusetts are aroused over the scourge. In view of the fact that the moths are so heavy that they can scarcely fly, especially so the female, it would be supposed that the spread of the pest would be slow—limited at least to the crawling speed of the caterpillar, but this is not so. The caterpillar drops down on passing vehicles, attaches himself to the clothes of pedestrians, and is moved with all sorts of articles, especially firewood. By these different modes of locomotion the spread is rapid.

And now comes the other part of the story—the gipsy moth at last is to be vanquished. One humble missionary in Japan, it is more than likely, will some day have the credit for accomplishing more in the battle against the moth than all the hundreds of thousands of dollars—yes, millions—that have been spent so far in the fight, and more than the immense army of men who have fought with their hands against the devastating and wandering gipsy.

GETTING DOWN TO THE BOTTOM OF THINGS.

In the early seventies, after serving in twenty battles of the Civil War, Rev. Dr. H. Loomis went to the land of the Mikado as a missionary, with the



PARASITE, ENLARGED TWENTY-FIVE TIMES, THAT FEEDS UPON THE GIPSY MOTH CATERPILLAR.

especial object of spreading copies of the scripture. He represented the American Bible Society, and has continued that service until the present day.

Being something of a naturalist, and an especial student of entomology, Dr. Loomis about twelve years ago noticed that Japan was afflicted with the gipsy moth, but that its ravages were not felt in the land of the Mikado. Some force seemed to hold the moth in check, and prevent its destructiveness. He puzzled over the reason for this; then studied the moth and its habits closely. He found that a parasite, so minute as to be barely seen without the aid of a magnifying glass, fed upon the moth in its caterpillar state, and counterbalanced its propagating and ravaging power.

Even before this it had been known that various insects attacked the gipsy moth in Europe, where it is quite common, but these insects did not seem to serve the desired purpose when brought to the United States.

Dr. Loomis communicated his discovery to Professor Riley, then government entomologist at Washington, D. C. That official replied to the missionary that efforts were being made to destroy the pest by other means, and that it would be unnecessary to import this insect from Japan. However, he asked that some specimens of the ichneumon fly, as Dr. Loomis called it, be sent him for inspection.

"In compliance with this request," said Dr. Loomis recently, "I sent to the United States some cocoons of the parasite, but when they arrived it was found that the specimens had been destroyed by a secondary parasite.

"With this failure to supply the insect that was valuable the interest in receiving further shipments seemed to die out. I watched the reports of the work being done in Massachusetts, and learned that, as some of the best entomologists had predicted, it had turned out a failure.

"On the death of Professor Riley I opened a correspondence with his successor, Dr. Howard, and also with the head of the Gipsy Moth Commission, in Massachusetts. The United States minister to Japan also became interested in the matter and attempted to make shipments of the ichneumon flies by express. Unfortunately the wood of which the cage was constructed shrank on the ocean voyage, and the parasites escaped.

MALE GIPSY MOTH—SLIGHTLY ENLARGED.

FEMALE GIPSY MOTH—SLIGHTLY ENLARGED.

"The United States consul-general in Yokohama learned the facts, and sent a report to the Department of Agriculture—and so eventually forty thousand parasites were brought into the United States and released in the infected districts of New England. The experiment is

PROF. TREVOR KINCAID.
He was sent to Japan by the United States Government to fetch home the gipsy moth parasite.

being watched with great interest, and promises to be a decided success, unless some unforeseen complication arises to render ineffectual the attacks of the parasite."

In order to insure the safe importation of the Japanese flies, Prof. Trevor Kincaid, of the University of Washington, at Seattle, one of the foremost entomologists of the country, was sent to Japan, and under his personal supervision the colony from which so much is hoped was brought across the Pacific in safety, after the previous discouragements.

Professor Kincaid since then accepted a commission from the government to make a trip to Russia to carry forward other studies of the European parasites, and from this journey he recently returned to America. He is particularly hopeful that the Japanese fly will solve the great gipsy moth problem, and he believes it will. Depending upon the results of experiments now in progress, other shipments of the fly will be brought to America.

The interest of the late E. H. Harriman in zoology, entomology and kindred subjects brought Professor Kincaid into close touch with the railway magnate. The Seattle scientist was in the party of savants that Mr. Harriman took to Alaska on his expedition of a decade ago, the object being to study the animal and plant life of the northern coast. Professor Kincaid was frequently entertained at the Harriman home. Several of his scientific works are accepted throughout the world.

Dr. Loomis has received letters of thanks for his discovery, one being from the Department of State, at Washington, transmitted through the consul-general at Yokohama. It reads:

"It is my pleasure to inform you that I have been instructed by the Secretary of State, U. S. A., to present to you the thanks and high appreciation of the government for the valuable services you have rendered. The persistence with which you have followed up your observations, and the earnestness with which you have pressed upon the officials of the United States government the importance of making a study of the enemies of the gipsy moth in Japan, is indicative of the best spirit and type of Americanism."

In the last report of Secretary Wilson, of the Department of Agriculture, he said:

"Parasites of the gipsy moth have been introduced which bid fair to rid New England from the present danger to orchards and forests, and the rest of the United States from prospective danger. There seems to be no doubt that this imported parasite will multiply to such an extent as to render the gipsy moth no more harmful than many of our leaf destroying caterpillars."

THE INSIDE-OUT OF THINGS

By CHARLES E. CRAVEN

THE greatest discoverer of modern times, or indeed of all the centuries, is Professor Quidam Quaternion who has solved the problem of the fourth dimension. During the years of his earlier investigations the scientific world regarded him as a harmless enthusiast, classing him with cranks who have attempted to square the circle or establish perpetual motion. When he declared last year that he had acquired the ability to *think* in four dimensions he was set down as absolutely crazy and hopelessly so, but now that he is actually working in four dimensions he can no longer be disregarded by either scientific or practical men. He is either a worker of miracles or he has opened up to all men possibilities that will revolutionize science and human activity. When at Cambridge recently before a company of distinguished scientists he turned an orange inside out without breaking the skin or spilling a drop of juice, and then as easily and deftly restored the ball of fruit to its common condition with the rind outermost, every one of the trained observers felt unable and unwilling to believe his eyes, but upon comparing notes and finding that the testimony of all eyes agreed, they were constrained to admit that here was something new under the sun that the eyes of King Solomon had not seen.

In the lecture that was illustrated by this marvelous performance the Professor acknowledged that it was difficult to explain this seemingly miraculous feat to men who declared they could not conceive of the fourth dimension, yet to himself it was as simple as lifting a book from the table before him and replacing it with the other side up. Divested of technical expressions his attempt at explanation was as follows:

"If," said the Professor, who is an unassuming gentleman with clean cut features and straightforward manner, "you will imagine a creature with a conception of one dimension only, you have a creature that can imagine motion only forward and backward in a straight line. Suppose him to have a rigid line, six inches long, pointing north and south. He cannot possibly reverse this line. He can move the entire rigid line northward or southward, but he cannot possibly transpose the ends without going outside of his one dimension. Now comes along a creature of a higher order who can see two dimensions, length and breadth. His field of vision and activity is not a line but a plane. He swings the rigid line around in his plane on its center as a pivot and presently the north end

"I Simply Move the Orange Into the Fourth Dimension—"

points south and the south end north. It is a miracle to the creature whose vision and activity are limited to a straight line. To him the ends of his rigid line disappeared for a moment. He saw nothing but its middle point. Suddenly the entire six inches of line came into his view again, but turned end for end. Now a third creature, a man, comes along and mystifies the second creature. This second creature knows the plane with its length and breadth, but cannot conceive of direction up and down. He has a plane surface, without thickness, golden on its upper side and silvered on its lower. He can move this back and forth or sidewise, and he can swing it about a pivot in his plane, but he cannot conceive of its being reversed so that the upper side shall be under and the under side upper. The man says, 'I will show you something new,' and he rotates the plane surface half a turn on a linear axis, and lo, the silver is above and the gold below! Nothing could be simpler to the man, but the creature of the plane has witnessed a miracle: all of his plane surface except a line across its width suddenly vanished from his sight, as suddenly to reappear reversed. Instead of rotating the figure on an axis in its original plane the man might have simply lifted the figure up out of that plane, as I lift this book, reversed it, as I turn the book over, and replaced it again in its original plane, upside down, as I replace the book on the table. In that case the entire figure would have vanished from the sight of the creature of the plane, presently reappearing suddenly, bottom side up.

THE INTELLIGENT BURGLAR OF THE FUTURE WILL FIND HIS WORK EASY.

"Now I come to you who know only three dimensions. You see this orange but cannot conceive of its being turned inside out without violence or miracle, any more than the creature of one dimension could conceive of the line being turned end for end or the creature of the plane could conceive of the surface being turned upside down. I simply move the orange into the fourth dimension — it vanishes from your sight. I return it to the space you are familiar with— it suddenly reappears reversed, turned inside out. No miracle has been performed, the structural integrity of the orange has not been altered, nothing more has happened than the swinging of the line through a second dimension or the swinging of the plane through a third dimension. I have simply swung the orange half a turn through a fourth dimension. Let me complete the revolution,—the orange now reappears to you as it was originally." This was effected by a quick motion of the Professor's hand that was as difficult to follow as the deft motions of a juggler. Exactly how it was done the spectators could not determine, but the reversed orange disappeared, not gradually but instantaneously, and as suddenly reappeared in natural form.

Professor Quaternion said that he had frequently turned small animals inside out, exhibiting to plain view the working and condition of their internal organs.

This is accomplished without violence to the animal, although the internal organs themselves as well as the whole animal are turned inside out. It might be thought that this process could be accomplished successfully with large animals and with human beings, to facilitate the diagnosis of obscure diseased conditions and for surgical operation, as well as for the study of anatomy and for physiological demonstration, but the difficulties here are many as will appear later. One difficulty lies in the fact that living beings cannot long endure the reversed condition. A man turned inside out by a semi-revolution in the fourth dimension would suffer no more violence than a man turned upside down by a semi-revolution in the third dimension. But just as a man when stood on his head suffers from cerebral congestion if long kept in that unnatural position, so a man turned inside out would suffer from what might be called peripheral congestion in the organs that are now turned outward but intended by nature to remain inward. It might be supposed that a part of a man, as the hand for instance or the head, might be turned inside out for surgical purposes, but the Professor pointed out, when this was suggested to him, what is obvious upon reflection, that it must ever remain impossible to reverse part of a man without subjecting the whole man to the reversing process. It would be just as impossible, of course, to do this as to upset one end of a table without upsetting the other end. The human wrist is marvelously flexible and will turn the hand in three dimensions, but it will not suffice for four. It was on this account that the Professor turned the orange inside out by tossing it into the fourth dimension by a peculiar and obscure motion and catching it again as it reappeared, reversed. He explained that if he retained his hold of it and carried it into the unseen dimension it would be necessary for his entire body to go with it, and when it reappeared he would reappear, himself also turned inside out. The outside of his hand, then inside, would still be in contact with the outside of the orange, then inside. This obscure conception he clearly illustrated by reminding his audience that the hand in turning a book over turns itself over at the same time and maintains its hold upon the same portion of the book's surface. For the Professor to turn himself inside out with the orange would probably be fatal, for contact with foreign substances would be exquisitely painful to his sensitive internal organs, and under such conditions he might find it impossible to exert the energy necessary to propel himself into the fourth dimension so as to turn himself right side out again. Any object that he is strong enough to toss into the fourth dimension disappears and immediately returns to view reversed, inside out. This he repeatedly illustrated with stones, boxes, eggs, etc. The egg does not run, as when broken, but suffers a natural exchange of interior and exterior no more violent or destructive than in the process of rolling it over on a table.

WITH THE AID OF A FEW BARS OF INTROVERTED BALLAST AERIAL NAVIGATION WILL BE SIMPLE.

Professor Quaternion opens letters without breaking their seals, and can turn

a small burglar-proof safe inside out without troubling about the combination. That the money and books in the safe are also reversed in the process does not inconvenience him, for he can restore them singly to their original shape at pleasure. If his method should become common property the only protection against burglars will be to make all safes so heavy that a company of burglars will not be able, though combining their effort, to turn them in the fourth dimension.

The visible effect of an insufficient revolution in the fourth dimension, that is, less than a semi-revolution, is remarkable. The object remains invisible, or is visible only in a plane section of its solid content, until the semi-revolution is completed. This the Professor explains by reminding us that when the line swung about a point the central point only was visible to the eye that could see in only one dimension, and that when the plane surface is revolved about a linear axis the axial line only is visible to the creature of two dimensional perception. Similarly the solid must be rotated in the fourth dimension about a plane section, and the plane section only will be visible to the eye that can take in only what is embraced in three dimensions. In this way it is easy for the Professor to exhibit to view for any length of time any desired cross-section of a solid. Thus a cross section of a block of wood or of a man's body or of any other material substance may be leisurely examined and measured, in the shape of a mathematical plane, with length and b r e a d t h but absolutely w i t h o u t thickness. The body still exists, of course, on both sides of the cross section, but it cannot be seen, and, what is more, it cannot be felt, being outside of the three dimensions which our senses of sight and touch can recognize. It is possible therefore to study a cross-section of the human body passing right through the center of the heart, for instance, to touch it, to photograph it, to measure it unimpeded by the surrounding body, a body existent and yet invisible and intangible. This is the application of the new science that bids fair to be of inestimable service to the medical profession. Probably the psychologist also will learn much when it is possible for him to study any desired cross-section of the brain, observing the phenomena attendant upon intellectual processes.

For lack of a better word Professor Quaternion has given the name of introversion to the process of turning an object inside out by reversing it in the fourth dimension. The most remarkable effect of introversion is its reversal of gravitational attraction. This is not yet satisfactorily explained but is in keeping with the general law that introversion reverses natural phenomena. An introverted body no longer has weight, its gravitation being replaced by levitation. An orange or a stone introverted must be held down, just as it required to be held up before introversion. An introverted shoe must be laid on the ceiling just as the normal shoe is laid on the floor. An introverted egg will fall upward and break on the ceiling and run over it without dripping down, just as a normal egg broken on the floor will run over the floor without dripping up. An introverted anvil, if let go, will crash through the ceiling and roof and soar skyward just as a normal anvil if dropped might break through the floor into

HEAVY SUIT-CASES MADE TO WEIGH NEXT TO NOTHING BY SHUTTING UP IN THEM A FEW INTROVERTED FLAT-IRONS.

the cellar. Professor Quaternion lost a valuable watch recently, letting it slip through his hands after introversion.

This of course makes all flying machines thus far invented mere toys. Professor Quaternion can introvert a ton of iron and its ton of weight is converted into a ton of levitation. It will require a ton of weight to hold it down. With any lesser weight it will soar. The near future will see Professor Quaternion floating wherever he will in the atmosphere in a ship actually lighter than air, made so by the simple introversion of ballast. The ship can be lifted to any desired height by the gradual introversion of bars of iron and lowered again by gradual reintroversion of the ballast. A less spectacular but exceedingly useful application of this principle is in the lightening of heavy loads. A ton of baggage in a wagon can be counterbalanced by a ton of introverted iron bars laid underneath the body of the wagon, and the wagon is drawn along as easily as if it were empty. A heavy suit-case can be made to weigh next to nothing by shutting up in it a few introverted flat-irons when the packing is done.

The one obstacle to general use of introversion is that up to the present time Professor Quaternion has been unable to initiate any other person into the enjoyment of his secret. He has tried faithfully to instruct others, but no one yet has been able to imitate the peculiar motion with which he tosses a body into the fourth dimension. He is inclined to believe that others can achieve success like his only by following his method of laborious study until ability to think in the fourth dimension is achieved, and then the ability to do wonders such as his will follow. For the present he is the only introversionist in the world. What man has done man can do, but for a time the world must wait. There is some compensation for this delay in the thought that incalculable power for evil as well as for good is indefinitely postponed. If introversion became common seals on letters and locks on light boxes would be worthless as protection against dishonesty, and a malicious introversionist meeting his enemy on the street might suddenly turn him inside out and send the poor helpless wretch soaring to the heavens.

A Canadian Boat-Song

Faintly as tolls the evening chime,
Our voices keep tune and our oars keep time.
Soon as the woods on shore look dim,
We'll sing at St. Ann's our parting hymn.
Row, brothers, row, the stream runs fast,
The Rapids are near, and the daylight's past!

Why should we yet our sail unfurl?
There is not a breath the blue wave to curl!
But when the wind blows off the shore,
Oh! sweetly we'll rest our weary oar.
Blow, breezes, blow, the stream runs fast,
The Rapids are near, and the daylight's past!

Utawas' tide! this trembling moon
Shall see us float over thy surges soon.
Saint of this green Isle! hear our prayers,
Oh! grant us cool heavens and favoring airs.
Blow, breezes, blow, the stream runs fast,
The Rapids are near, and the daylight's past!

—THOS. MOORE.

He Wouldn't Be Noticed

STOUT PARTY—I want two seats, please.

USHER—Certainly, madam. And what about the little boy?—*Pick-Me-Up.*

Consistency

"IT seems to me that your husband is not of a very even temper."

"Oh, he certainly is. He growls the whole time."—*Rire.*

Much Less Trouble

ENRAGED CREDITOR—"I've had enough of mounting all these stairs every day to collect this bill.

DEBTOR—"Well, I can tell you a piece of news that will please you. After tomorrow I'm going to live in the basement."—*Pele Mele.*

The Piece de Resistance

"DID the—ah—prisonah offer any—ah—resistance?"

"Only a shilling, your wushup, and I wouldn't take it."

Not as Good as His Word

"I give you my word, the next person who interrupts the proceedings," said the judge sternly, "will be expelled from the court-room and ordered home."

"Hooray!" cried the prisoner.

Then the judge pondered.—*Judge.*

Just Good Enough

GEORGE—"Do you think that I'm good enough for you, darling?"

DARLING—"No, George, but you're too good for any other girl."—*Illustrated Bits.*

The Simple Life

A TRAVELER in Georgia observed a big negro leaning heavily against a fence in the shade of a cottonwood tree. Drawing rein he inquired: "Tired, George?"

The negro showed disgust. "Tiahed? Who, me? No, suh, ah'm not tiahed. Ah'm a hoeing this yere patch o' co'n, an' ah'm waitin' foh the sun to git down so's ah kin go home."—*The Circle.*

At the Baths

ROBUST OLD GENTLEMAN (to sick lady)—"When I came here first, I hadn't strength to utter a word, I had scarcely a hair on my head. I couldn't walk across the room, and had to be lifted from my bed."

SICK LADY—"You give me hope, kind sir. How were you cured?"

ROBUST OLD GENTLEMAN—"I was born here."—*Rire.*

Might Have Asked for Her Foot

HER FATHER (crustily)—"You ask for my daughter. Why, sir, at your present salary you couldn't more than keep her in gloves."

SUITOR—"Well, wouldn't that be enough?"

HER FATHER—"Do you mean to insinuate, young man, that my daughter would only wear gloves?"

SUITOR—"Pardon me, sir! I asked only for her hand."—*Judge.*

In Desperate Straits

"WHAT do you think of a man with a rip in his coat and only three buttons on his vest?"

"He should either get married or divorced."—*Boston Transcript.*

There Was No Answer

AT an important State function in London blue tickets were issued to persons of high rank admitting them to that part of the hall reserved for members of the royal family. Less distinguished guests received white tickets. Through some mistake an important public man received a blue card, his wife received a white one.

When the couple reached the audience chamber there began to be trouble, inasmuch as the lady firmly declined to be separated from her husband. An aide endeavored to reason with her, pointing out the dreadful consequence that would follow a mingling of blue and white.

"How absurd!" exclaimed the lady. "What do you take us for—a Seidlitz powder?"

She was permitted to enter with her husband.—*Everybody's Magazine.*

How He Landed Her

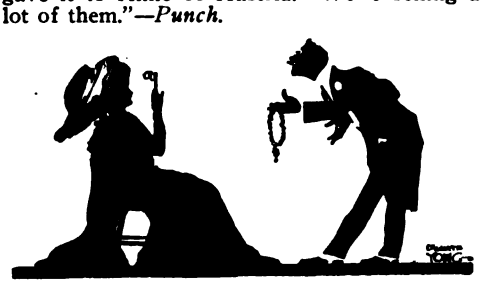
He proposed while up in his aeroplane;
"I shall land her this time." he thought;
Then he did, in a way he had not wot,
When a lever slipped and caught.
—*Sturm's Oklahoma Magazine.*

Asking for Guldance

A REPORTER called on a rector to ask him if he had accepted a bishopric that had been offered to him. The servant said that her master could not be seen. He was at prayer seeking for guidance. Then could the reporter see the rector's wife? "Oh, no!" said the slavey, "you can't see her. She's busy packing up!"—*The Circle.*

No Sale

SALESMAN (lately promoted to curio department)—"This necklace, Madame, was originally made for the Duke of Buckingham, who gave it to Anne of Austria. We're selling a lot of them."—*Punch.*



Good Enough

WIFE—"I suppose if you should meet some pretty young girl you would cease to care for me."

HUSBAND—"What nonsense you talk! What do I care for youth or beauty? You suit me all right."—*M. A. P.*

Single Blessedness

EMERSON—There's nothing like single blessedness!

WATERS—What? This sounds strange from a happily married man.

EMERSON—I know. But I was very much afraid that the doctor was going to say "twins" last night.—*The Circle.*

His Choice

JUDGE—"You are privileged to challenge any member of the jury now being impaneled."

"Well, then, yer honor, Oi'll foight the shmall mon wid wan eye, in the corner, there ferninst yez."—*Metropolitan.*

The Exception

IT was married men's night at the revival meeting.

"Let all you husbands who have troubles on your minds stand up!" shouted the emotional preacher, at the height of his spasm.

Instantly every man in the church rose to his feet except one.

"Ah!" exclaimed the preacher, peering out at this lone sitter, who occupied a seat near the door and apart from the others: "You are one in a million."

"It ain't that," piped back this one helplessly, as the rest of the congregation turned to gaze suspiciously at him. "I can't get up; I'm paralyzed!"—*Tit-Bits.*

What They Say

LONDON school-boy blunders in the New York *Sun's* London correspondence:

In India a man out of cask may not marry a woman out of another cask.

Romulus obtained the first citizens for Rome by opening a lunatic asylum.

Algebraical symbols are used when you don't know what you are talking about.

A renegade is a man who kills a king.

The press today is the mouth organ of the people.

A lie is an aversion to the truth.

Women's suffrage is the state of suffering to which they were born.

POPULAR · SCIENCE & MECHANICS SUPPLEMENT ·

ANIMATED ORANGES

IF it were not verified by an "undoctored" photograph, that caption would be unbelievable, and even with a picture it stretches the imagination. If we were advertising Southern California, we'd let it go at that, but not being subsidized, we might as well come down to the hard, cold verities. They are oranges, all right, California oranges, oranges from Orange County—but made of the succulent *papier maché*. During the recent Elks' celebration in Los Angeles, they were worn in the parade of Santa Ana Lodge.

TWO TROPHIES OF THE ROOSEVELT HUNT.
The dik-dik and water buffalo in contrast. The tiny skull at the left is the dik-dik.

RANKS OF ANIMATED ORANGES.
Odd costumes worn by members of the Elks in a recent carnival at Los Angeles.

AMERICA'S BIGGEST GUN.
Fourteen-inch rifle for our navy that uses 365 pounds of powder at a shot.

AMERICA'S BIGGEST GUN

THE photograph reproduced herewith illustrates the largest and most powerful gun for use in naval warfare that has ever been adopted in the United States. It is of fourteen inch, forty-five caliber type, having a weight of sixty-three and three-tenths tons and a length of fifty-three feet six inches. When loaded on a flat car for shipment at the steel works at Philadelphia, it projected over almost half its length and a second car was required to put in front of it so that it might be coupled to a freight train.

On test this gun required a charge of 365 pounds of powder to propel the projectile, weighing fourteen hundred pounds, which at a distance of nine thousand yards penetrated armor plate of twelve and six-tenths inches thickness. This is the only fourteen-inch gun made at the present time for the United States Navy and further tests will determine whether it will be adopted for use in making all of our battleships of the big gun type. It is claimed that some sixteen inch guns are to be made, but it is doubtful if they will ever be utilized for our battleships; certainly not at the present time.

PLANT MAKES IMPRESSION ON STEEL

IMPRESSIONS of plants and animals on stone are found quite often, and although it seems surprising that the softer material should have left an impression on the harder, an interesting experiment has given a very simple solution for this. A piece of moss was laid on a polished piece of hard steel, and on it a cartridge filled with dynamite was placed. This was ignited by means of a fuse, and the enormous pressure of the explosion forced the bottom of the cartridge into the steel, at the same time leaving an impression of the moss, which was placed between the two. Our picture shows the impression made by the bottom of the cartridge as well as that left by the moss.

PLANT MARKS STEEL.
Impression of moss in metal made by exploding dynamite above it.

BIG SANDSTONE QUARRIES

THE world's largest sandstone quarries are located in Ohio a few miles to the south of Lake Erie in the vicinity of the towns of North Amherst and Berea. From these quarries also come vast quantities of our whetstones and grindstones and there is very much that is of interest about the industry here carried on. One of these quarries for example has been mined to a depth of 165 feet in places and the distance around it is a mile and a half. Looking into this pit from one edge, one is reminded of the ruins of some ancient coliseum for the walls are cut in shallow terraces which are not unlike the seats of an open-air theater of the ancients.

In cutting a block of sandstone wedges are driven in sidewise at the base of the block while steam drills bore holes from the top to meet the openings made by the wedges. A machine called a channeler then cuts the block away.

HUGE SANDSTONE QUARRIES.
View gives an idea of how blocks are cut out from largest quarries in the world.

WHERE THE CACTUS IS KING

PERHAPS in no other place in the United States is there such a dense and riotous growth of plants and shrubs of the thorny varieties as in the lower valley of the Rio Grande. It is only a few years since the agricultural development of this broad scope of territory in far southern Texas was begun. A comparatively small part of the land has as yet been cleared, and on every side is to be seen the primitive wilderness of giant prickly pear and many other species of the cactus family, interspersed here and there with towering yucca trees, or Spanish dagger as they are commonly called, nut palms, mesquite and ebony trees and other vegetation of a semi-tropical character. In most places this growth is so dense as to be impregnable except by following the narrow goat- and wild animal-trails that wind through it. Many of the prickly pear plants are fifteen to twenty-five feet high. They bear an enormous harvest of fruit, known as the tuna, each year. This fruit is a delicious delicacy for the myriads of birds and other animal life that make their habitat in the chaparral. It is also relished by the native Mexicans and is one of their staple articles of food during the summer and fall.

WHERE CACTUS LINES THE ROADS. In the Valley of the Rio Grande, where the thorny plant is king.

NEW FORM OF SUN-DIAL. English invention that is an improvement on old style.

ODD WINDMILL TOWER. Old stub used instead of expensive steel structure.

ODD WINDMILL TOWER

THE photograph shows a novel windmill tower located on a foot-hill ranch in Sonoma Co., Cal., at Healdsburg. By cutting the top branches, the owner has made a very serviceable windmill tower out of a vigorous young redwood tree. The well is bored at its base. The tank is located several hundred yards to the right on the top of the hill.

NEW ENGLISH SUN CLOCK

A NEW form of sun-dial called the Helio-chronometer is shown in the accompanying illustration. It is used in England for gardens, country estates, in parks and on terraces and balconies, offering all that is necessary for finding true clock time without calculation or allowances which were necessary with ordinary sun-dial.

There are two screens, one being pierced with two small holes through which the sun can cast a beam of light on to the other, which has a center line engraved upon it. On the underside of one disc is an eccentric which acts on a lever attached to the screen. The year circle is set to the current date. Then the dial or hour circle is turned round by taking hold of two finger grips so that a spot of light through one of the holes in the moving screen shines on the line engraved on the fixed screen. When the spot is bisected by the line the time can be read at the sector on the periphery of the dial.

The dial has the merit of greater accuracy than the older forms and is coming into favor for the purposes for which it is suited.

BINDING THE WHEAT.
Flemish women work habitually in the fields and seem happy in it.

WORKING WOMEN OF FLANDERS

IN Flanders, where the work of the homes and of the fields—even in some of the manufacturing industries—still has much that is almost primitive about it, women labor beside the men, or alone, everywhere. The photographs, reproduced herewith, show work in the fields. Contentment seems to be the portion of these people, and the happy faces in these pictures are typical of the signs of its general rule. In few lands is there more of this spirit, even where there is much more of ease. It is said of the women here that they are vigorous and happy, because of their hard work with their hands, not in spite of it.

WHEELING A GOOD LOAD.
Old Flemish woman harvests her own potatoes, and handles them like a man.

DIGGING POTATOES.
Woman who has worked a lifetime and still enjoys it.

MAKING WINE FROM FIGS

IF the expectations of those promoting the industry are realized, there will shortly be put upon the market a new wine, made from Madeira figs.

For some time an eminent Italian chemist has been conducting experiments, and he now asserts that the juice of the fig can be converted into a wine of excellent taste. It is asserted that not only is the flavor especially agreeable, but that the wine is very rich in phosphate matter and almost wholly destitute of tannic acid, qualities that render it unusually nourishing for invalids and children. The pulp resulting from the extraction of the fig juice is said also to create a new food for milch cows and fowls. Fresh figs contain but twenty-five per cent sugar, but after having been dried and prepared for making of wine, they show eighty per cent sugar.

Should the new scheme prove a success, there are a number of localities in the United States where it could be made a profitable industry.

A CUP OF COFFEE.
There seems no lack of good cheer here.

TO MAKE A STOUT GLUE

A GOOD formula for gluing emery to wood or metal is as follows: Take equal parts of white rosin and shellac, and melt them together. When this has been done, add a quantity of carbolic acid—in crystals—equal to the quantity of rosin or shellac used. The cement thus made has great adhesive power.

MAKING BRICK.
Young woman mixes clay with her bare hands.

ELASTIC FIRE ESCAPE

THE collapsible frame described in the following is a construction patented by Otto Lampé, of Baden-Baden, and was originally intended for use exclusively as a fire-escape. In this connection it is doubtless destined to prove valuable, possibly extremely so, in service.

When folded up, the frame is readily transported on a special heavy cart to the spot, there to be erected within less than four minutes. It comprises two enormous pairs of Nuremberg shears, the outside angles of which are provided with platforms enabling the inhabitants of all the stories in a burning house to be rescued simultaneously. In fact, the frame, which is nearly one hundred feet in height when extended, comprises as many as seven platforms, while two separate ladders, located opposite one another, allow of a safe descent and ascent. An adjustable bridge can be laid out from each platform to the window of the corresponding story. As these bridges are provided with rigid railings, even the most timid may use them, while injured people are safely transported over them to the platform. The frame is strong and safe.

EXTENSION FIRE-ESCAPE.
Made to scale up the side of a building like a gigantic ladder.

UNCLE SAM'S NEW DOCKS AT FRISCO

THE United States is now having constructed three very large transport docks opposite Old Fort Mason, in San Francisco, which, when completed, will be the largest on the Pacific Coast.

These immense piers will cost, when finished, in the aggregate, about two million dollars, and will require over two years in the building. The contract for the building of the docks proper was let last October, for the sum of $1,182,200. The contract calls for the completion of the three piers within thirty-six months from the date of the award. Active work was commenced at once, and has been pushed forward with all vigor ever since.

The above price does not include the complete improvements to be made at that point—according to plans made.

The sea wall will be 1,023 feet long, constructed of the best reinforced concrete. This wall will be twenty-five feet thick at the base, and fifty-seven feet high. The depth in front of the sea wall will be thirty-two feet at low tide.

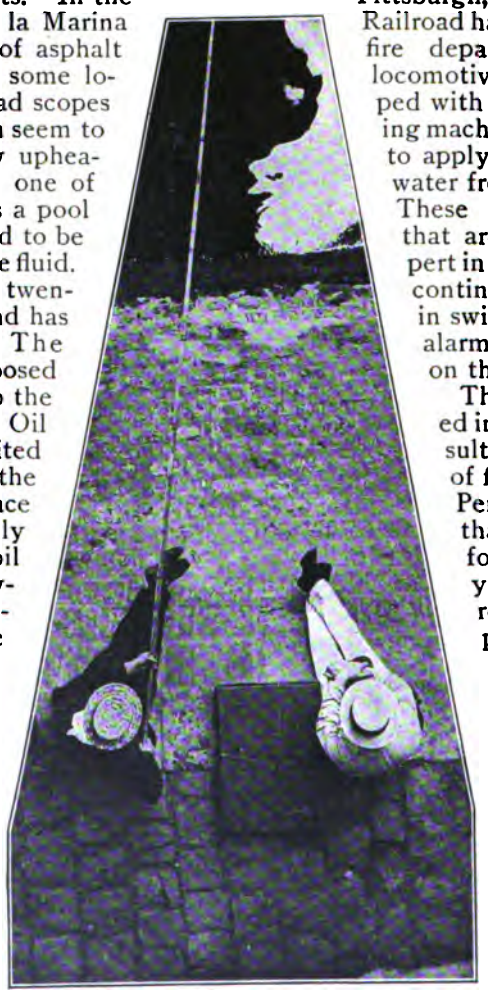
The docks will add a greatly needed improvement to San Francisco's harbor.

OIL SPRING IN MEXICO.
Queer find that causes no excitement because the flow is small.

LOCOMOTIVES USED TO FIGHT FIRE.
Engines of Pennsylvania road fitted with devices to use in emergency.

AN OIL SPRING IN MEXICO

THE geological formation of the territory lying between the Rio Grande and Panuco rivers in Mexico is remarkable in many respects. In the vicinity of the Soto la Marina River outcroppings of asphalt are to be seen. In some localities there are broad scopes of desert waste which seem to have been caused by upheavals of nature. In one of these barren spots is a pool of oil that is supposed to be fed by a spring of the fluid. This oil pool is about twenty-five feet across and has no surface outlet. The evaporation is supposed to be about equal to the replenishing supply. Oil experts who have visited the locality say that the existence of this surface pool is not necessarily an indication that oil will be found in paying quantities at lower depth. The source of the spring may be a limited supply of oil near the surface. Enterprising Americans, however, have acquired control of the land upon which the oil pool is situated and will exploit it for oil. Whether success crowns their efforts or not will depend entirely on further discoveries.



CONTENTMENT FROM OVERHEAD.
Roof view of two peaceful fishermen satisfied with a rod between them.

LOCOMOTIVES TURNED INTO FIRE-ENGINES

IN order to secure greater protection from fire to its property in and around Pittsburgh, the Pennsylvania Railroad has organized a unique fire department. Seventeen locomotives have been equipped with fire hose and pumping machinery, enabling them to apply a strong stream of water from their own tanks. These engines with crews that are fast becoming expert in fire fighting, operate continuously day and night in switching work, but fire alarms have the first call on their services.

The system now installed in Pittsburgh is the result of the development of fire protection by the Pennsylvania Railroad that has been going on for the past twenty years. The insurance records of the company show that considerable good has been accomplished by the fire-fighting engines and the number is now being largely increased, as the apparatus has been simplified and the amount of hose carried increased by substituting linen for cotton rubber lined hose. Other roads are watching the plan closely.

NO, THIS IS NOT A COMET.
It is an unusual photograph of the ray from a powerful searchlight.

PUTTING WOUNDED ON BOARD SHIP.
German berth built for ready transportation of occupants without disturbing them.

WASHED COAL

THAT which has done the most to ameliorate the smoke nuisance has been "washed coal." He who coined this term was no counterfeiter; his word-mint produced the real article. Washed coal does not mean that black coal has been put through a laundry process which transforms the dark mineral into an albino fuel but the process employed actually washes away all those impurities which go to make ash and clinkers. "Washed coal" is bituminous coal which has been separated from the slate, clay, iron and other ash producing impurities present when the coal comes from the mine. The separation is accomplished by jigs with the aid of water and the process calls for a large plant installed near the shaft top of the coal mine.

WASHING COAL.
Apparatus for cleansing new mined coal of impurities.

SKELETON OF A BEAR-HUNT

THIS curious picture is really a bear hunt with a man on horseback and a dog. The picture is the skillful work of a man who arranges skeletons as the bones are arranged in life. The skeleton of the man is in just the position he would occupy if on horseback with the horse on its hind legs, while the position of the dog is also very natural. This group is in a museum in a university in the state of New York.

BEAR HUNT IN SKELETON.
New York school has a novel display of bones in active pose.

NOVEL ROLLING BERTH

A NOVEL rolling berth, constructed by Herr S. Kaumann, captain of the Hamburg - American Line, was used recently at the German maneuvers for the first time. This ingenious novelty in the field of sick-nursing enables the wounded to be conveyed from the ship to the land and farther on without being removed from their beds, combining in a single construction the properties of rolling berths, hand stretchers and field beds. It can be folded up entirely and as each of its parts is readily removed is easily disinfected.

"Eight Times Eight Are Sixty-Four."

finger of one hand with the proper finger of the other hand and close those below. Now take the number of closed fingers of one hand and multiply it by the number of closed fingers of the other hand and the product is the units of the answer sought. Now take the total number of open fingers, counting the thumbs as fingers, of course, and multiply it by ten and mentally set it down in the tens place, and the result is complete and correct.

To illustrate with an example: let us multiply eight by eight. Thus, touch the middle finger of one hand with the middle finger of the other hand. There are then two closed fingers on the hand representing the multiplicand and two

HOW TO COUNT ON YOUR FINGERS

TO those to whom memorizing is laborious, and as a matter of interest and possible service to the average reader as well, it may be worth while to explain an almost mechanical process of multiplication of surprising simplicity by which the product of numbers as high as twenty-five times twenty-five, or even beyond, may be quickly arrived at.

The only requirement is that the fingers and thumbs be mentally numbered or labeled. Thus, let each thumb represent the figure six, each index finger seven, each middle finger eight, each ring finger nine, and each little finger ten. Let the fingers of one hand represent the multiplicand and the fingers of the other hand represent the multiplier. Touch the proper

"Nine Times Ten Are Ninety."

closed fingers on the hand representing the multiplier, which multiplied, the one

by the other, gives four to the units of the product sought. There are six open fingers in all to be multiplied by ten for the tens of the product, that is, sixty-four as the result, and the correct answer.

A more advanced course is also available by numbering the thumbs eleven, and the fingers twelve, thirteen, fourteen and fifteen, respectively, on each hand. The process is identical with that just described, with the exception that the open instead of the closed fingers are multiplied for the units, and a hundred added to the result.

Thus, to multiply fifteen by fifteen, which most of us cannot do without pencil and paper, multiply the open fingers of one hand by the open fingers of the other hand for units; multiply the sum of the open fingers by ten for the tens, and then add a hundred, and the total product is two hundred and twenty-five, correct again.

"Eleven Times Eleven Are One Hundred Twenty-One."

"Fifteen Times Fifteen Are Two Hundred Twenty-Five."

For numbers from sixteen to twenty multiplying the closed fingers for units; add the open fingers and multiply by twenty, and add two hundred, and the correct product is obtained.

This method is really very useful and if one will take the very small trouble necessary to learn the rules, he can become possessed of a valuable method of ready calculation that is unequaled within its limitations. Women have been much ridiculed for counting on their fingers, but any woman who learns this method will find she has an advantage in ready figuring over the average man when it comes to the higher multiplications. At which the superior male will not laugh.

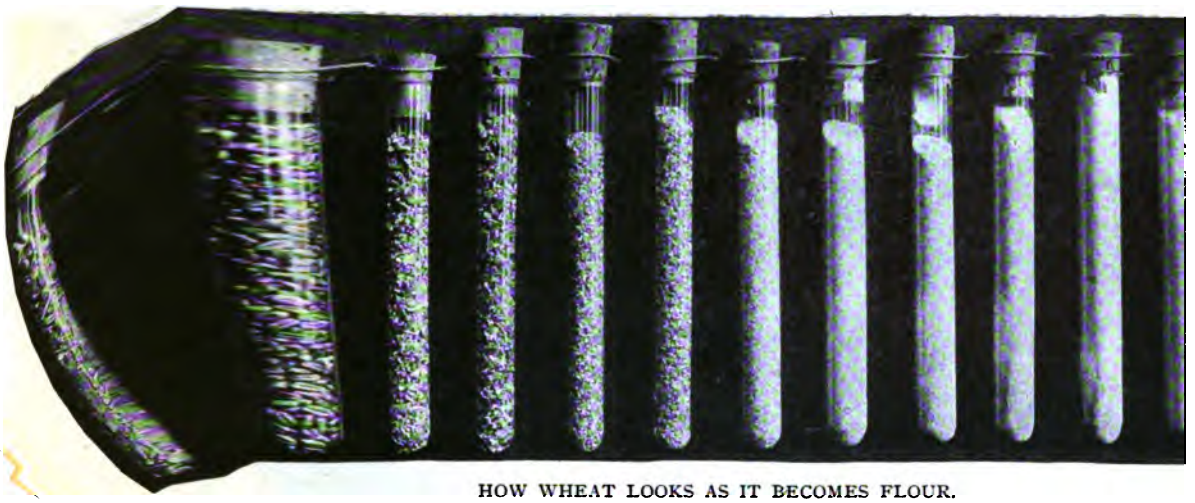
NEW ITALIAN HYDRO-PLANE BOAT

TWO Italian officers, Captain Ricaldoni and Lieutenant Crocco, have recently experimented on the Lake of Bracciano, in the neighborhood of Rome, with an interesting hydroplane of their own design.

The length of the boat is twenty-six feet, three inches, and she is fitted with a Clement-Bayard 80-100 Horse-Power motor, working at a speed of 1,200 revolutions per minute. The boat is provided with hydro-planes at its stem and stern. The propellers, which have each a weight of over twenty-six pounds, are of doubled aluminum plating; their pitch can be altered while running, and they can be reversed. Including all machinery, fuel, etc., and two men on board, the vessel weighs 3,300 pounds. When running, the boat rises, so that the hull becomes clear of the water. At the speed of forty-four miles per hour, the hull is about eighteen inches out of the water and the planes feather along the surface lightly and easily.

HUGE SINGLE STEEL CASTING
Giant riveter frame cast in one piece weighing 90,000 pounds.

A NOVELTY IN HYDROPLANES.
Boat that runs by aid of air-propellors, the invention of two Italian officers.



HOW WHEAT LOOKS AS IT BECOMES FLOUR.

At the left is the raw, dusty wheat; at the right the finished, refined flour. Between are the results at various stages of manufacture.

BOAT CLIMBS UP HILL

AN Italian engineer, Signor G. Bartolomei, of Rome, has recently designed an extremely ingenious scheme destined to replace the complicated operation of present canal locks. Bartolomei's arrangement comprises a paddle wheel movable with its axle fitted with wheels to run on iron rails, on the banks. The boat is driven uphill by the water, contained in an inclined canal, flowing against the wheel, causing it to revolve and, therefore, to turn the wheels on the rails, thereby pushing the boat forward. The gradient of the canal is intermediary between three and seven per cent and need by no means be constant throughout its length.

BOAT CLIMBS UP HILL.

Downward flow of water turns rear paddle which causes propelling wheels to travel on track on the banks.

CLEANING OLD BRICKS

WHEN soft coal smoke has spoiled t appearance of pressed-brick it c be removed easi Make a mixture follows: One pi of liquid ammoni one gallon s soap; two poun powdered pumi A soft, pasty su stance should the result. Bru the dust off t brickwork. The apply the mixtu with an ordina new whitewa brush. At the e of some twen minutes take scrubbing brus and use it vig ously. Rinse do with a hose, clean with a lar sponge and luk warm water. T bricks will co out as if new. T method is very us ful for the tre ment of exterio ornamental stru tures, and for terior brick-work

SNAKE SWALLOWS BOAR

THE accompanying photograph shows a Tiger Snake sixteen and one-half feet in length, which was caught on the Island of Java. After taking the skin off the snake and opening its stomach, a young wild boar, weighing one hundred and one pounds, was found inside. The boar, of course, was dead, but in perfect condition otherwise.

The snake could not have survived his heavy meal.

TIGER SNAKE GAVE HIS LIFE FOR A DINNER.
Serpent swallowed a live boar but the meal caused his death.

ALCOHOL MOTOR BOAT A SUCCESS.
Recent application of new motor to small type of vessel at Washington, produces satisfactory results. This fuel is expected to become a favorite for motor-boating when it is produced cheaply.

HANDLING CONCRETE ECONOMICALLY

A CONVENIENT way of handling concrete is shown in the accompanying photograph. The concrete is mixed at the base of the tower, or scaffolding, and raised on a small elevator running between two T rails. The hoist bucket dumps automatically into a hopper and this, in turn, is connected with the long tubes of metal which carry the concrete to the moulds. One or more cranes suspend the tubes over the moulds which are to be filled, and the whole operation is accomplished with no unnecessary labor and in the shortest possible time. The photograph shows the work on the first story of a big office building in Los Angeles, California.

The device saves hauling the mixture about on top of the rising building, in barrows or otherwise. The cranes can be swung to any position and can reach a very large part of the walls of a good-sized building. It promises to be a useful device.

EXTRAORDINARY CRANE HANDLES BUILDING MATERIALS.
New style of hoist used for carrying concrete up to top of rising walls.

CURING CHILIS IN ARIZONA

ONE of the prettiest sights of domestic life in the southwest is the array of scarlet chili peppers hung up to dry on the adobe walls of the rancher's home. They are strung in five foot lengths, hundreds of them to a string, and suspended in the sunshine and dry wind of the desert until thoroughly cured. The photograph herewith was taken in the courtyard of old Fort Lowell, one of the historic military posts of the Southwest. It is located a few miles from Tucson, Arizona, and is one of the most picturesque of American ruins. The entire courtyard surrounding the barracks was festooned with these scarlet garlands, and the sunlight made this picture dazzling.

CURING CHILIS.
The festoons are a brilliant scarlet and when drying make a fine sight.

ENGLAND'S LATEST ARMY GUN

RECENTLY an English firm of gun makers has designed a very interesting automatic quick-firing gun. This new piece is in principle of the same construction as the English service gun, with all the latest improvements embodied. Advantage has been taken of using high class steel and aluminum in the construction of certain parts, instead of gun metal, whereby a reduction of thirty-three per cent in weight has been obtained. This gun is fitted with a new pattern muzzle attachment by means of which the accumulation of fouling is practically eliminated, which enables it to be fired continuously without losing time in cleaning out the muzzle. The piece is entirely automatic.

IN THE RIOT SQUARE.
Picturesque and useful drill of naval apprentices at Newport.

NEW BRITISH ARMY MACHINE GUN.
By means of a new muzzle attachment, fouling is eliminated and the piece can be fired continuously.

ROUNDING THE WORLD IN A BARREL

ON June 20th, 1909, Mr. and Mrs. Vianello started at Venice for a trip around the world in an exceedingly comical vehicle, viz., a barrel. This they divided into two parts, on the one side a seat, and on the other a bed which can always be used by one of the travelers for sleeping and resting, while the other one is keeping the barrel in rotation.

Their first destination was Paris, which they reached safely, and they are now on the way to London, and from there expect to go to Belgium, Holland, Denmark, Sweden, Norway, and other countries, in a trip around the world.

TRAVELING IN A BARREL.
Scheme of a Venetian for novel trip around the world.

UNUSUAL ELECTRIC ELEVATOR.
Novel installation at a popular Swiss hotel.

AN ORIGINAL ELECTRIC LIFT

AN interesting and somewhat novel form of electric lift has recently been installed at one of the new hotels at St. Moritz in the Engadine, Switzerland. The hotel is built on the hillside overlooking the lake at St. Moritz-Dorf, and the lift, which partakes also of the nature of an inclined cable railway, is used for conveying passengers from the lower level to the main floor of the hotel. The car resembles that of an ordinary lift, but is mounted so as to always hang vertically, swinging on an axis supported by trolleys running on elevated rails, as will be seen in the illustration.

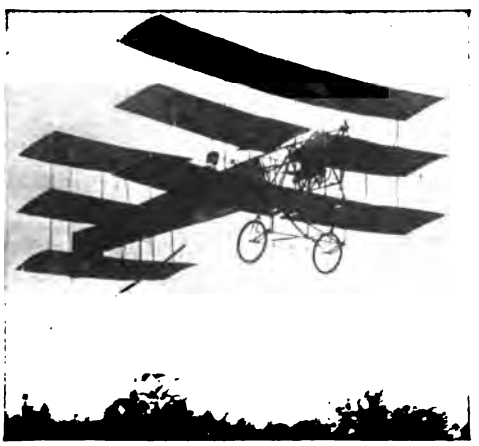
CITY SUPPLIED WITH WATER BY MULE-POWER.
Scene in Brownsville, Texas, where water-supply is peddled from a barrel-cart.

THE SCHERL MONORAIL CAR IN ITS AMERICAN TEST.
This is the gyroscope car that was recently tried in New York, and that rivals the Brennan invention.

AN UMBRELLA FOR CABS

AN ingenious device, which will be appreciated by cab owners and passengers alike, has been designed by M. Maurice Picard of Paris. As the ordinary umbrella does not afford immediate protection from rain, while leaving the passenger entirely unsheltered during the time required for alighting and paying his fare, the inventor suggests fitting to the roof of the cab body an umbrella, or awning, that opens automatically with either of the doors. The photograph illustrates the very simple and reliable working of this apparatus, which can obviously be removed and replaced at a moment's notice and at owner's desire.

AUTOMATIC CAB UMBRELLA.
Shield at top of door spreads itself over alighting passenger's head.



NEW ENGLISH TRIPLANE A SUCCESS.
Machine of A. V. Roe that has attracted attention by recent flights.

SUCCESSFUL ENGLISH TRIPLANE

A. V. ROE'S machine, which he has named the "Bull's Eye," is a duplex triplane remarkable for its lightness in weight. The three main superposed surfaces are 20 feet by 3 feet 7 inches each, set at an angle of 5 degrees, and spaced 3 feet 9 inches apart. The three superposed rear planes, forming the rear rudder, are 10 feet by 3 feet 7 inches, set similarly to the front ones, and are 15 feet 10 inches behind the front ones. The two sets of planes are joined at their centers by a triangular frame with the apex of the triangle downwards. The operator sits in this frame about four feet behind the main front planes.

BURNT EARTH CARRIAGE DRIVE.
British Guiana finds this a good material of which to make roads.

BURNT EARTH FOR CARRIAGE DRIVES

VISITORS to Georgetown, British Guiana, South America, are impressed most of all by the beautiful and well kept carriage drives that are to be seen in the Botanic Gardens. The material from which the drives are constructed and maintained is manufactured from alluvial mud or clay, the process of preparation is simple and inexpensive.

A large pit is dug about twenty feet square by fifteen feet deep; this is partly filled with logs arranged upon each other crosswise and covered over with the soil excavated until it forms quite a heap; the pit is then fired through an opening left for ventilation.

In about two weeks the mass is thoroughly baked and resembles a heap of red bricks, with the exception that the particles are smaller than ordinary bricks; this material is called "Burnt Earth." Of this the roads are made, the earth being spread upon them and crushed down with a heavy steam-roller. The result is an excellent driveway, hard and durable. The photograph gives only a faint idea of such a road.

PURE ASPHALT IN MEXICO.
The precious mineral has been found in quantities but too far from transportation to be marketed yet.

ASPHALT IN MEXICO

SEEPAGES of pure liquid asphalt are to be seen in a number of localities in the state of Tamaulipas, Mexico. In some places this mineral product oozes from the earth in sufficient quantities to form small lakes. The Mexican ranchmen look upon these ponds and soft spots upon their land as veritable death traps for their live stock. The animals often mire down in the sticky substance and die before they can extricate themselves. Wild water fowl often alight upon the surface of the liquid asphalt and are firmly caught in its fatal grip.

These asphalt deposits are so isolated from railroad transportation facilities that no effort has so far been made to exploit them in a commercial way. They have been visited occasionally by American hunting parties who regarded them more as an interesting phenomena of nature than as having any possible commercial value worth developing.

SIX HUNDRED BARRELS OF OIL.
An idea of what lake barge traffic is may be had from this photograph as a side light on what river traffic may become.

DIET THAT HELPS CONSUMPTION

B. J. KENDALL, M. D., of Geneva, Ill., claims that the most certain method ever adopted for the cure of the "Great White Plague" is through the diet used by directions given below which can be taken at home and comes within the reach of the poor as well as the rich.

The modus operandi is to force the body to take on fat, a desideratum long felt by the medical profession but never before attained to.

The all important thing is to drink large quantities of milk strippings—the very last of the milking. This seems so simple and easy that many have refused to follow directions and demanded medicines to cure them; but there has not yet been discovered any medicine that is a specific for consumption.

To get best results a healthy cow should be selected, one that does not cough and one that gives very rich milk. A Jersey cow is preferable. The milk should always be tested to be sure that there is a large per cent of cream in it.

The last quart should be milked into a separate dish which rests in a larger vessel containing warm water just sufficient to prevent the strippings from cooling below blood heat. The cow should be thoroughly cleaned to prevent any dirt getting into the milk so the patient can blow back the froth and drink at once without straining as this cools it too much.

Begin by drinking nearly a pint in the morning and the same at night and increase the quantity gradually so that in ten or fifteen days a full quart will be taken twice a day. It should be taken immediately after milking before it has had time to cool at all. All should be taken that can be without too much discomfort and then after two or three minutes' rest drink more and rest again, and so on until a full quart has been taken as rapidly as it can be conveniently. In about fifteen minutes the patient should eat at the table such articles of food as are known to agree with the stomach. At noon eat as usual.

DESTROYER THAT WAS DESTROYED.
Disastrous effect of collision upon an English vessel. Deck and plates torn.

TEACHING CHAUFFEURS TO START MACHINES.
Novel device in automobile school for giving instructions in handling engine.

ELECTRIC LOCOMOTIVE IN LONDON.
New machine used on City & South London Railway.

PUNCTURING THE TAPE.
Typewriter prepares telegraph message for automatic sending.

RECORDING TELEGRAPH INSTRUMENT

A NEW method of rapid recording telegraphy has recently been devised that is of much interest. When it is desired to send a message, the first step consists of the preparation of a tape by means of a perforator, this device having a keyboard similar to a typewriter. Instead, however, of printing the letters as struck, it translates them into a telegraphic code and punches them in the paper tape.

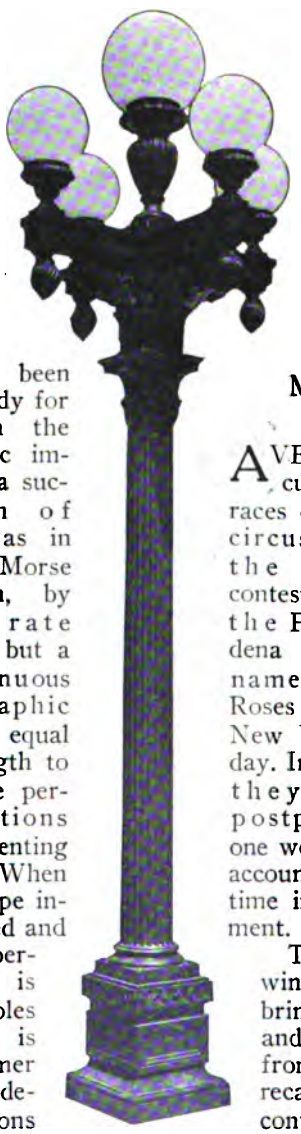
When the message has been punched on the tape, it is ready for automatic transmission. In the new transmitter, the electric impulse is not broken up into a succession of dots, as in the Morse system, by separate holes, but a continuous telegraphic signal equal in length to all the perforations representing a letter is sent over the line. When unpunched portions of the tape intervene, the current is reversed and so maintained until fresh perforations appear. As there is only one row of message holes in the tape, the transmitter is distinctly different from former models, in which the signals depend upon the relative positions of message holes arranged in two rows. In the new transmitter the signals depend on the relative positions of perforated and non-perforated units of tape.

RECEIVING AUTOMATIC TELEGRAM.
Perforated tape reproduces message in print on this machine.

At the receiving station a recorder, consisting of a punching magnet and a spacing magnet, punches holes in the receiving tape, thereby, of course, making a duplicate of the sending instrument's tape.

When the record tape has been made, it may be used in several ways, as for transmission over other circuits, to run through a printer and the signals translated into printed letters, or it may be used with a linotype machine to set itself in type.

SENDING THE TELEGRAM.
Machine which automatically sends message punched on a tape.



AN ORNAMENTAL STREET LIGHTING POST.
Type of the new style appearing in better lighted cities.

MODERN CHARIOT RACING

A VERY different sport from the cut-and-dried Roman chariot races of the circus are the real contests at the Pasadena Tournament of Roses every New Year's day. In 1910 they were postponed one week on account of the rain, for the first time in the history of the tournament.

MODERN CHARIOT RACE.
Event that is a feature of Pasadena's tournament of Roses.

The prizes of $1,000 for the winner and $500 for the loser bring out some genuine rivalry, and the famous chariot race from "Ben Hur" is sometimes recalled by the efforts of the contestants to get the "pole" or inside position, while making the curve at a two-minute clip.

Thoroughbred race horses are used for this sport and the drivers are trained for weeks.

WELDING BY TORCH.
New process makes separate pieces of a vessel into one.

AUTOGENOUS WELDING

OXYGEN and acetylene in a blowpipe flame produce the highest temperature—6,300 degrees—of any flame known as a product of combustion. It is 1,200 degrees higher than the oxy-hydrogen flame and nearly equals the electric arc. A device for welding, by means of this flame, is proving very successful. This process is valuable for replacing riveting and brazing in many instances. Two sheets of metal may be welded by placing their edges in contact and following along the seam with the blowpipe. Practically seamless steel and copper tanks of almost any shape and size may be made by forming the body and ends separately and tracing the seams where the pieces meet with a blowpipe. Many designs and forms not otherwise possible to construct are made practicable and feasible by this process. This autogenous welding process is especially valuable in the foundry as the blow-holes and similar defects in castings and forgings are made good. Cast iron, wrought iron, steel castings and forgings, copper, brass, bronze and aluminum in many forms of construction are effectively welded either in the manufacture of new parts or in repairing accidental breaks. Any shaped hole can be easily cut in steel plates up to six inches in thickness, also, as with the blowpipe the operator can accomplish cutting feats impossible with an ordinary saw.

CUTTING BY FLAME.
Using a torch to divide a steel shaft.

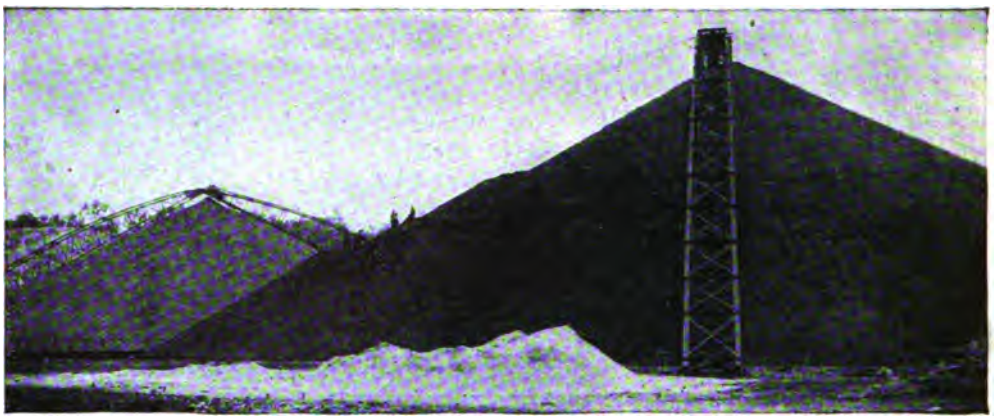
HANDSOME MEMORIAL.
Fine tower and clock erected as monument at Providence, R. I.

NEW RAILROAD SIGNALS

MAKING the white light a warning signal on railroads is a reversal of the custom which has prevailed since the first days of railroading, yet the system has been adopted by some roads and is likely to come into general use. The New Haven road, the West Shore, and the Subway system in New York have abolished the use of the white light, thereby making it a danger signal in not recognizing it. As in the old system, red still means stop, or danger, but the cautionary color is orange, while the clear signal is green. The reason is that a broken lamp shows white.

NEW RAILROAD SIGNALS.
Scheme that uses white for danger and green for clear.

GROUND SEMAPHORE.
The paddles are painted yellow. Position indicates signal.



COAL PILES THAT ARE WORTH A MILLION DOLLARS.
Reserve kept by New York Edison Company, to provide against a famine.

MILLION DOLLAR COAL PILE

TWO hundred thousand tons, one million dollars' worth of coal; what a guarantee against a fuel famine should the country be subjected to another coal strike! This is what the New York Edison Company had recently stored up for a rainy or better yet, a cold day, at Shadyside, New Jersey. While the world may possess bigger coal piles it is to be questioned if the United States does at the present time, certainly not in the eastern states. To be exact, there are two and a half piles, the only reason for this division being that the limit of the standard coal-handling machinery was reached before half the coal was piled up, consequently a second and a third heap had to be started. Each pile occupied the area of a city block, rising as high as a four-story house. Seen from New York City these heaps are usually mistaken for part of the landscape as foothills of the Watchung mountains. In front of the mass is an electric sign clearly decipherable at night in New York, which reads "Coal Storage, 200,000 tons."

STATUE THAT CAUSED TROUBLE.
Gen. Robt. E. Lee, in Confederate uniform, placed in National Capitol caused criticism, but the statue remains in place.

RECOLORING SILKS

A DISCOVERY of great importance to manufacturers of and dealers in silks has been made by a chemist and engineer of St. Etienne. By the use of this invention, the color may be taken out of silk, and it may be recolored in any desired tint without injury to the fabric, and it will entirely do away with the danger of injuring silks through coloring by means of too strong chemicals, which eat the fabric.

There are thousands of yards of silks stored away in warehouses, which, owing to fading or discoloration, or the passing out of style of the particular shade, are an absolute loss to merchants and manufacturers, but which, by means of the new process, it is claimed, may be recolored and made as attractive as any new silk.

The process is said to be a secret one, but results are reported that are surprising. It is probable that the method will be heard from in this country in the near future, and it may be that a decoloring preparation will be put upon the market for general and popular use.

WOODEN TOY INDUSTRY IN GERMANY

FOR hundreds of years Germany has been the principal producer of toys and it is interesting to notice that although nowadays there are huge factories making the thousands of different toys that frequently may be called works of art, and very often can walk, ride or perform other intricate movements, there still exists in some of the small mountain villages the centuries old industry of carving toys out of wooden blocks. For generations the whole population of these places has been turning out the same kind of toys with the same primitive tools. Parents as well as children are working at this, each one having a specialty, the one making cows, another horses or sheep, etc., and they are so skillful that the articles are almost as much alike as if made by machinery, and are finished in a surprisingly short time.

While this industry is carried on in the same old fashioned manner, the factories, of course, have also taken up this branch of toy making, and our photograph gives an interesting picture of it. The outline of the article to be produced—its silhouette it may be called—is mechanically cut out of a long block of wood, or turned out in a circular form, which if cut crosswise at proper intervals, gives dozens of the desired article in its rough outlines, and the finishing touches can then be applied very easily and quickly.

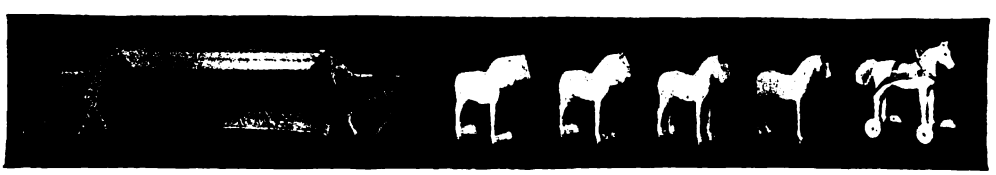
REMARKABLE ILLUMINATION. Metropolitan tower, New York, as it looks when lighted up at night.

TO DESTROY FLEAS

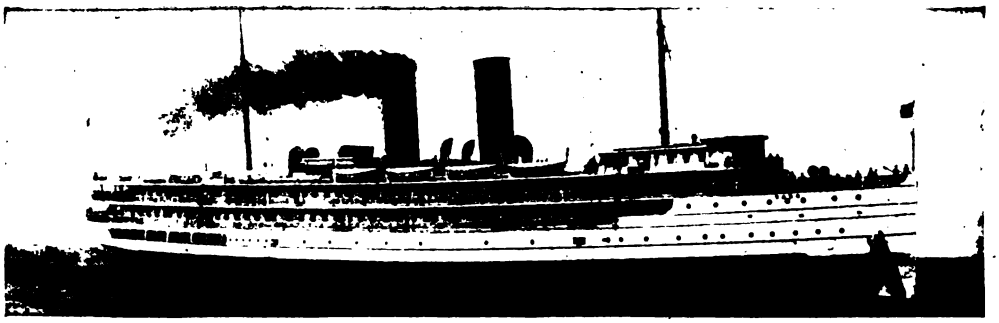
MANY owners of dogs and cats, especially when the animals have the run of the house, are much annoyed by fleas. No amount of ordinary washing will rid an animal of these little pests; the cleaner the dog or cat the more the fleas seem to thrive.

The Imperial Entomologist of the Government of India, in a recent leaflet, says that the best method of destroying fleas, is the free use of crude-oil emulsion, which consists of 80 per cent of crude petroleum mixed with 20 per cent of whale-oil soap. This combination makes a jelly which mixes freely with water, and is generally used at 3 per cent solution. At 10 per cent solution it destroys fleas with perfect certainty. It may be applied to the floors and walls of houses with any ordinary garden sprayer. An animal washed with the emulsion will be entirely freed from the pests.

This is a remedy that may easily and cheaply be tried and it will undoubtedly be welcomed in portions of the country where fleas are a nuisance if not a menace.



HOW THE GERMANS MAKE CHEAP TOYS.
Form is turned out on a lathe, then sawed, then shaped by hand and mounted.



SUCCESSFUL TURBINE COAST STEAMER.
One of the swift boats that speed between New York and Boston.

HAMMER-HEAD OR TITAN CRANE

THE accompanying photograph shows an interesting crane, capable of dealing with exceptionally heavy loads. It has been recently completed at an English shipyard. It consists of a square tower, 125 feet in height, carrying a horizontal jib, having a total length of 240 feet; the long arm being 150 feet in length. The jib is supported upon a ring of live rollers, and is capable of making a complete revolution in either direction, with lifting and racking motions. It is, we are told, the largest crane of its type yet completed.

The crane can lift a weight of 150 tons, with a speed of somewhat over five feet per minute, and with this load it can make a revolution in about ten minutes. Machinery of this type grows more ponderous and powerful every year.

HUGE CRANE IN HARBOR WORK.
Hammer-head that lifts 150 tons between ship and wharf.

HANDSOME MODERN LIGHTING IN BUSINESS STREET.
Brilliant display is taking place of semi-darkness in well equipped cities.

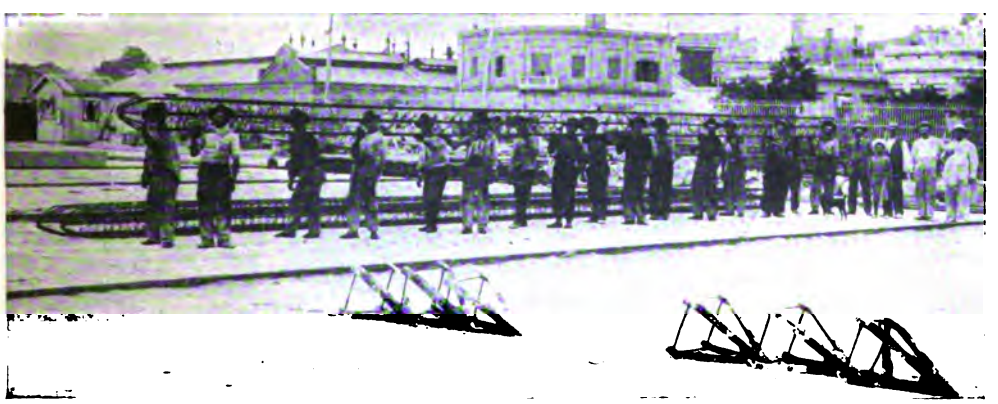
CARS FOR TREMENDOUSLY HEAVY SHIPPING.
Double set of trucks under a massive truss, bears casting for 5,000 ton press.

DEEP-SEA SOUNDING

DEEP-SEA sounding is part of the work of the hydrographic survey. It is done with a mechanical reel instead of by hand, and a thin piano wire takes the place of the lead line. Depth is measured by the number of revolutions of the reel, the diameter of which is known, as the lead moves through the water. If the depth is great, steam is used to wind in the wire as the pull would be too much for a hand reel. The place of the sinker of the hand line is taken by a mechanical device holding a weight, usually a hundred pound ball, which is released at the bottom, thus facilitating the inhaul. Sometimes other devices are used, which bring up samples of the deep sea bottom.

When the work is done in sight of shore, position angles are taken with sextants from small boats.

DEEP SEA SOUNDING-DEVICE.
Steam apparatus for handling "lead" at great depths.



NOVEL FRAME FOR CONCRETE PILES.
New method of reinforcement for piles made on the surface. Note "heads" lying on pavement in the foreground.

GASOLINE WEED BURNER

ON the Union Pacific Railroad, a car that is intended for nothing else but to burn out weeds that grow between the tracks, has been doing useful service for a number of years. Its appearance is more like a huge old fashioned snow-plow, than like any other piece of the road's rolling stock. In front are three wide, platform-like plates, which project flat over the track. Under each is a series of gasoline burners, which are fed from tanks carried at the sides of the car behind. Back of the burners is a huge fender, erected to protect the men operating the car, from the heat of the flames. When the burners are lighted the car runs along the road and the fire is forced downward, under the burner-plates, upon every living thing between the rails. As the flames are plentifully fed and very hot, the result is the utter blighting of weeds of all descriptions.

GASOLINE WEED BURNER.
Flame burns under the shield in front and destroys track weeds.

Railroads have much trouble with weeds which not only disfigure the tracks but actually injure the roadbed when allowed to grow without regular checking. This device, however, will put an end to the difficulty wherever it is used systematically. The expense of operating the "fire-car" is not great and its work is effective and sure.

REMARKABLE COLLAPSIBLE LADDER.
New German invention that raises or lowers ladder by crank power.

FLOODS AT PANAMA

HEAVY and continuous rains along the canal zone caused the Chagres River recently to rise so high as to flood almost everything from Bas Obispo to Gatun. The canal at Bas Obispo, showing a steam shovel nearly submerged, and where work has been hindered because it filled with water, are shown in the accompanying photograph. The Isthmus Canal Commission maintains stations from the headwaters of the Chagres River down nearly to the Gamboa Bridge. These observers make note of all changes and telephone their observations to the head office at Culebra. Whenever they predict a flood, orders are at once issued to all towns that are in danger and arrangements are made at once by the police of the towns to force the people to leave their homes. Some absolutely refuse to leave their houses as, when the police notify them to leave, there is no sign of the river's treacherous flow and they cannot understand how the Americans know when the river is going to rise beyond its banks.

FLOODS AT PANAMA.
Water sometimes makes much trouble on the canal.

These conditions will be changed and corrected when the canal is finished but floods have to be fought now, among obstacles that nature seems to delight to put before the engineers.

NEW GERMAN AIRSHIP

THE airship devised by Franz Clouth at his Rhenanian Caoutchouc factory, at Cologne - Nippes, comprises a torpedo-shaped gas envelope one hundred and forty feet in length by a diameter of twenty-seven feet, and having a capacity of about 60,000 cubic feet. The envelope is made of special gummed cotton tissue manufactured at the Rhenanian factory. The gas-bag contains a double section balloonette which rests on the bottom of the balloon, the idea being to secure greater stiffness of the fabric. The car is carried immediately beneath the center of the envelope, and is slung from longitudinal wooden beams, secured to the fabric by means of substantial straps. These beams, extending almost the entire length of the envelope, similar to a vessel's bilge keels, serve to stiffen the bag longitudinally. The wood lengths are secured to one another, to form a continuous beam by means of plugs, so that they can be easily dismantled for transportation.

The balloon is not intended to rival the Zeppelin airship, but was built as a cruising dirigible which can be readily transported.

THERE'S ALWAYS ROOM AT THE TOP.
This painter was photographed on the flag-pole at the top of the Singer Building, 600 feet above the street.

NEW GERMAN AIRSHIP.
Made of gummed tissue and stiffened with longitudinal beams from which the car hangs.

FOR "SHOOTING UP" BALLOONS.
New German swivel gun made specially for the purpose of fighting airships.

SOUND MAGNIFIER FOR TELEGRAPH INSTRUMENTS

THE sound magnifier, as the name indicates, is intended to take up the weak sound produced by a telegraph instrument and, by magnifying it, to deliver it to the operator in a volume great enough to serve all requirements. The magnifier is adjustable so that it will give out a very weak tick or a sound that can be heard above all other instruments in an operating room, as desired by the operator.

As the signals are magnified directly from the main line relay the use of a sounder is done away with and as the sounder is done away with the necessity for the local batteries is also overcome. As the local batteries add no strength to the main line current and the magnifier adds no labor to the relay it will be seen that the doing away with local batteries, sounder and resonator will effect a great saving. The signals from the magnifier are delivered to the operator through a horn which not only assists in magnifying the sound but acts as a perfect resonator. In offices where many instruments are working at the same time, this device is very useful in isolating a single message.

TELEGRAPH MAGNIFIER.
Device that intensifies sounds of Morse instruments and materially helps operators.

STATION ANNOUNCERS ON STREET-CARS

ONE of the greatly needed improvements for rapid transit service is some form of automatic station announcer, placed in a conspicuous position on the car. The present method, under which the name of the next station is called out by the guard, is little better than a farce. Reproduced herewith are photographs of a new device which automatically announces streets or stations, so that all passengers in the car may see and read. The names of streets and the advertisements are put on a web, the ends of which are fastened to opposite rollers, this web to be unwound from one roller and wound upon the other. As the car is advancing along its route, a circuit closing device on the trolley pole will strike its counterpart, which is put on the first cross wire supporting the trolley wire that is met after a crossing is passed, thereby closing momentarily an electric circuit coming from the wire that supplies current to light the car. This current, in passing through the circuit into the machine, energizes an electric magnet, and passes out through the ground wire. The duty of this magnet is to release an automatic switch, which turns on a separate electric current into a small electric motor, which is by suitable gearing connected to the two web-carrying rollers, each of which can by means of a lever be thrown in gear with the motor, or cut out, as, very naturally, when one roller is in gear with the motor the other must be running loose.

TROLLEY ANNOUNCES STREETS.
Spoke of attached wheel strikes pendant arm on trolley wire, as it nears each street to be announced.

COMBINED ANNOUNCER AND ADVERTISER.
Inside the car, the street name is shown in the block before it is reached.

The motor being thus set in motion will drive one roller forward, winding the web upon the same, and unwinding the web from the other roller, which is now running loose, thus bringing a new street name to view. Ads are also run in the same manner.

The long felt want of the public for something of this sort, seems to be adequately met by this invention, and if some method can now be devised to overcome the necessity of passengers standing in the aisles, it will be possible to learn at any moment, from the seats, just where your car is.

PANAMA FORTIFICATIONS BOARD.
Sitting, left to right: Brig. Gen. Wm. Crozier, Brig. Gen. T. H. Bliss, Brig. Gen. Arthur Murray, Brig. Gen. W. W. Wotherspoon.
Standing: J. E. Powell, Sec'y; Maj. W. J. Hann, Brig. Gen. W. L. Marshall, Capt. H. S. Knapp, Commander Wm. J. Maxwell.

NEW DEVICE FOR CANADIAN WOODS.
This engine has a sled for a forward truck and the already well-known caterpillar device upon its drivers. It travels readily over snow-roads, hauling huge loads.

ENDLESS BELT TO FILL WAGONS.
New device planned to end the use of wagons in excavations.

SAVING THE HORSES

AN important invention for the digging of foundations has been made by the architect, Herman Müller, of Berlin, in a machine which has been constructed, that may be quickly and easily adjusted to carry with comparative ease large quantities of earth from the proposed foundation. Above all, the enormous cruelty to animals which one witnesses daily by the old method can thus be avoided. The apparatus consists of an endless belt conveyor, which is movable and carries earth from excavation to wagon as the photographs show.

CARRIES EARTH UP TO STREET LEVEL.
Conveyor can be shifted to convenient points and saves the hardest hauls heretofore made by teams.

A DRY-LAND CRAFT

IN order to give the summer residents at the seaside a genuine deep-sea feeling, the builder of this quaint abode lent it a decided nautical twist. This lodge is known as "The Ark" and combines some of the advantages of both land and marine architecture; for instance, the brick chimney not only takes care of the smoke, but also prevents the vessel from pitching in the high wind. The Ark is one of the curiosities of La Jolla—pronounced La Hoya—California.

HOUSE THAT IS HALF AND HALF.
Dwelling that is part ship, built at La Jolla, California.

TO CLEAN STAINED BOTTLES

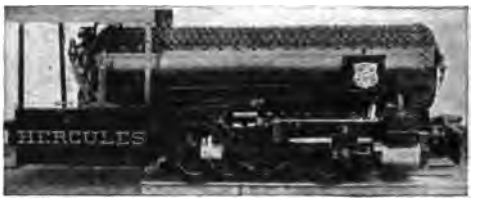
A GOOD way to get the stains out of bottles is to fill them half full of water and then put in a handful or two of cast iron borings, coarse ones preferred; shake well. It will clean any bottle no matter how badly it is stained. The boys in one shop use it for cleaning their tea bottles and it works all right.

FLANGELESS CAR WHEELS

THE accompanying photograph shows the under-car arrangements of a recent invention to do away with flanges on car wheels. The flat wheel of the coach can be seen at the right of the picture. In the center, at the bottom, can be seen the third, or middle rail, gripped by a pair of wheels whose duty is to keep the car on its rails, and, in case of electric-power, to transmit the current to the motors. The inventor has shown ingenuity, but fails to convince us that his device has any usefulness or purpose of any sort other than merely to be different from existing apparatus.

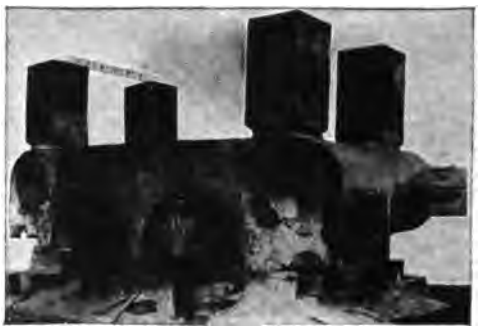
NOTE THE THIRD RAIL UNDER THIS CAR.
The small wheels on vertical arms run on the sides of this rail and keep the flangeless car-wheels on the track.

BOILER FOR HUGE LOCOMOTIVE.
Erie engine-giant's steam-generator that furnishes power to haul the longest trains in the world. Scene in the shops.



SAFE ENGINE FOR A POWDER FACTORY.
Compressed air locomotive designed specially for work where fire cannot be permitted.

UNUSUAL NEW BRIDGE AT OPORTO, PORTUGAL.
Novel form of structure which is new to engineering. Bridge has two levels with steel arch between.



ONE OF THE LARGEST CASTINGS EVER MADE.
Tremendous steel press made for the Carnegie Steel Co. Exact weight, 351,575 pounds.

HIGH-WATER CARS.
How some of the river towns transported citizens during the floods on the Ohio. Cars were raised from three to four feet above the pavement.

TWO THOUSAND JAPANESE CHERRY TREES.
Presented to the City of Washington by the City of Tokio. They are to be planted along the new speedway in the American Capital.

YARD FULL OF CEMENT POSTS.
These posts are now used to a very large extent by the railways for fencing. They cost less and are better than wood posts.

INTERESTING NEW TOW-BOAT HULL.
Vessel is designed for heavy traffic and is built more on lines of hydroplane than on the usual deep-hull plan heretofore familiar.

CARNEGIE INSTITUTION AT WASHINGTON.
Twelve million dollars were given by the steel man for this building and endowment, to encourage scientific research.

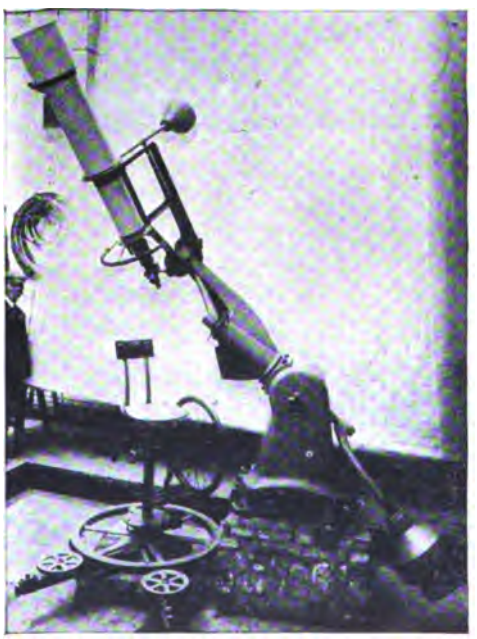
NEW DOCKS AT SAN FRANCISCO.
Work is actively in progress on new harbor facilities in the city that is rebuilding itself and docks are to be much improved.

COMET FINDER AND ITS "CAGE."
New telescope and the frame of its dome, not yet completed.

UNIQUE COMET-SEEKING TELESCOPE

THE accompanying illustrations show a novel form of telescope recently constructed at Jena, Germany, known as the "Comet Seeker" and the novel method of controlling the position of the telescope by means of a sort of a bicycle wheel attachment on the seat for operation with one hand and movable sector near the eye-piece of the instrument for control by the other hand.

This instrument is mounted on a concrete and brick foundation for tests and is so delicately poised and balanced as to be moved in any direction desired by the observer without the slightest difficulty.



NEW COMET-SEEKING TELESCOPE.
Instrument mounted and ready for use.

CLEVER LITTLE INVENTOR

ONE of the cleverest boy inventors come to our notice is Master Mervyn Gunzendorfer, of San Francisco, Cal. Though only thirteen years of age, Mas-

A BOY'S AIR-SHIP.
"Tandem" biplane built by a thirteen-year-old inventor of California.

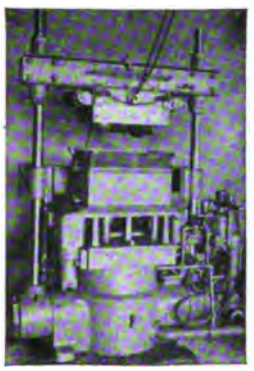
ter Mervyn has wrought out the details of a trial model of what is known as a "Tandem Biplane." In this work the lad was assisted, to some extent, by his little schoolmate, Master Jackson Musser, who is about Mervyn's own age. Young Musser's assistance, however, was merely in a suggestive way.

During the great Portola Festival, recently held in San Francisco, many public exhibitions were given of this model and with very successful results—each test trial being quite satisfactory. The longest flights obtained were from 300 to 500 feet, and, in altitude, from 150 to 200 feet—or, until the weight of the electric wires overcame the driving power of the motor.

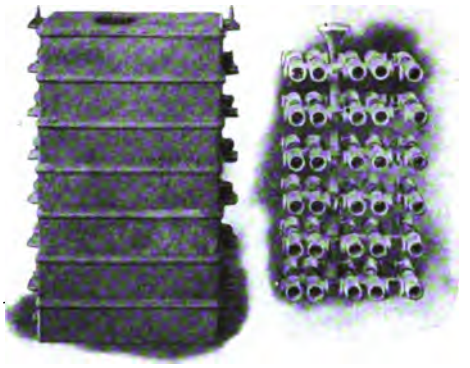
A full sized "ship" will be built from this model, about twenty-five feet long and will have an eight-cylinder gasoline motor. It is quite to be expected that we may hear of young Gunzendorfer as an aerialist.

STEEL CASTINGS IN JOB LOTS

TO what extent cold steel can be made to do the work of brawny arms, skilled hands, and nimble fingers, is graphically shown in the operation of a new molding machine. By the use of this new invention, multiple molding, that is, making many molds of the same pattern at the same time, the dream of foundrymen, is an accomplished fact. The machine will do things, with marvelous exactness, which hitherto have been considered impossible by practical men; and in truth its operations are both amazing and instructive. It is in this broadened use of molds, in stacking them one above the other as high as the pouring can be conveniently done, that is working such a revolution in foundry practice. The many schemes for multiple molding all failed because it was impossible to press an irregular shaped pattern down into a leveled surface of sand and get a perfect impression of the pattern. The production of a perfect mold is accomplished in the new method by projecting the sand upward against a pattern held face downwards with velocity enough to cause the loose sand to be thrown into every detail of the pattern.



PRESS FOR MAKING MOLDS.
Pattern placed in this machine can be duplicated any number of times.



SCHEME FOR MULTIPLE-CASTING.
New plan of "stacking" molds to produce many castings of one pattern.

TO MAKE A KALEIDOSCOPE

TAKE three pieces of mirror glass inclined against each other at an angle of sixty degrees, and enclose them in a cylinder made of pasteboard. Close the cylinder at one end by two glass plates, a transparent one and a frosted one. Leave a small space between these two plates and fill up with colored glass splinters. On turning it the glass splinters will change their positions, showing to the eye different images. The other end of the tube should be closed, with only a pin-point eye-hole.

A USEFUL CEMENT

A CEMENT which is effective for cementing rubber to iron and which is specially valuable for fastening rubber bands to band-saw wheels is made as follows: Powdered shellac, one part; strong water of ammonia, ten parts. Put the shellac in the ammonia water and set it away in a tightly closed jar for three or four weeks. In that time the mixture will become a perfectly liquid transparent mass and is then ready for use. When applied it forms a firm bond.

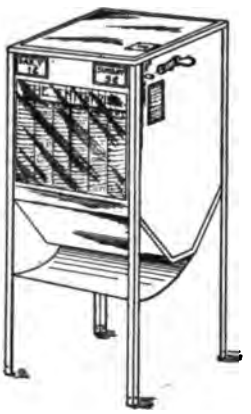
NEW GERMAN ELECTRIC TREATMENT.
Current is readily applied to any portion of the body by means of apparatus that concentrates its influence.

MACHINE SELLS NEWSPAPERS

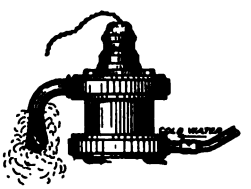
A COIN-OPERATED machine to sell newspapers, a clever and ingenious device was recently patented by Ambrose S. Carnell, New York City. The machines are about the size, and very similar in appearance to the dark green, oval-topped receptacles to be seen everywhere for the collection of mail packages. They are painted a brilliant French red, a strikingly conspicuous color.

One publication only may be sold from each machine, which has a capacity of from forty to one hundred papers, according to the number of pages the paper contains, and the whole upper half of the first page is plainly in view through a glass door in the front of the machine.

The coin-operating mechanism may be quickly changed to vend penny, two-cent, three-cent or five-cent papers by withdrawing a pin from one hole and inserting it in another. When set for a five-cent paper either a nickel five-cent piece or five pennies may be used. No adjustment of any kind is required to meet varying number of pages. The machines will take a single sheet or a big 100-page Sunday paper with equal facility and will deliver it readily on demand of the proper coin in the slot.



MACHINE SELLS PAPERS.
A penny or a nickel dropped in the slot brings a paper at a turn of the crank.



ELECTRIC WATER HEATER.
New English invention that serves useful purpose.

ELECTRIC HEATER IN USE.
It readily furnishes hot water instantly from a cold supply.

ENGLISH ELECTRIC GEYSERS

THE electric geysers shown in the accompanying illustrations work on an entirely different principle from the various electric water heating devices now in use, as the name implies. The electric geyser is attached to an ordinary water tap by a rubber hose and the cold water entering the geyser through this inlet pipe passes through a series of chambers which are in direct connection with the electric supply.

The water instantly becomes heated and issues in a hot stream from the discharge pipe of the geyser, the time elapsing between the turning on of the tap and the flow of hot water through the geyser being only a few seconds. It is stated that there are no wires or resistances employed in this electric geyser, and the apparatus is practically proof against short circuit. The small geyser for use in bed chamber or for dental fountain, supplying one pint per minute, uses one kilowatt per hour and is operated on alternating or direct current of one hundred volts or two hundred volts.

Such an appliance would be very useful in rooms for light housekeeping or in sick-rooms where hot water is not readily obtainable on an instant's notice.

ONE MULE CARRIES TWO OF THE GUNS, WITH AMMUNITION.

NEW GUN FOR THE ARMY

By ROBERT FRANKLIN

THE United States Army has a new gun. It is a portable machine gun, intended especially for cavalry use, and is called, after its inventors, the Benét-Mercié. One of its two authors, Mr. Benét, is a brother of Colonel Benét of the Ordnance Department.

The weapon is in its way decidedly a marvel. It weighs only thirty pounds—that is to say, one-fifth as much as the lightest machine gun used hitherto. A mounted man can carry it across the pommel of his saddle. Or the cavalryman may attach the barrel to one side of his saddle, and the stock to the other—each weighing fifteen pounds.

Two of the guns can be packed on one mule, one on each side of the animal, together with two extra barrels, for emergencies, and 1,200 rounds of ammunition—the whole weighing less than 200 pounds. Of this weight the ammunition represents 120 pounds.

The weapon is much like the army magazine rifle, but larger. Its calibre, however, is the same and it uses ordinary army rifle cartridges. Its ammunition is held in brass "feed strips," each of which holds thirty cartridges. These strips are easily reloaded, two men being able to reload 1,200 rounds in forty-five minutes. They are carried in boxes, ten strips to a box, weighing thirty pounds.

The new gun is served by two men. One carries the weapon and 300 rounds of cartridges; the other carries 600 additional rounds, or 1,200 if desired. In action, one man fires, while the other attends to the business of loading. But, if necessary, one man, carrying 300 rounds, can march with the gun and use it.

Its mechanism is remarkably simple,

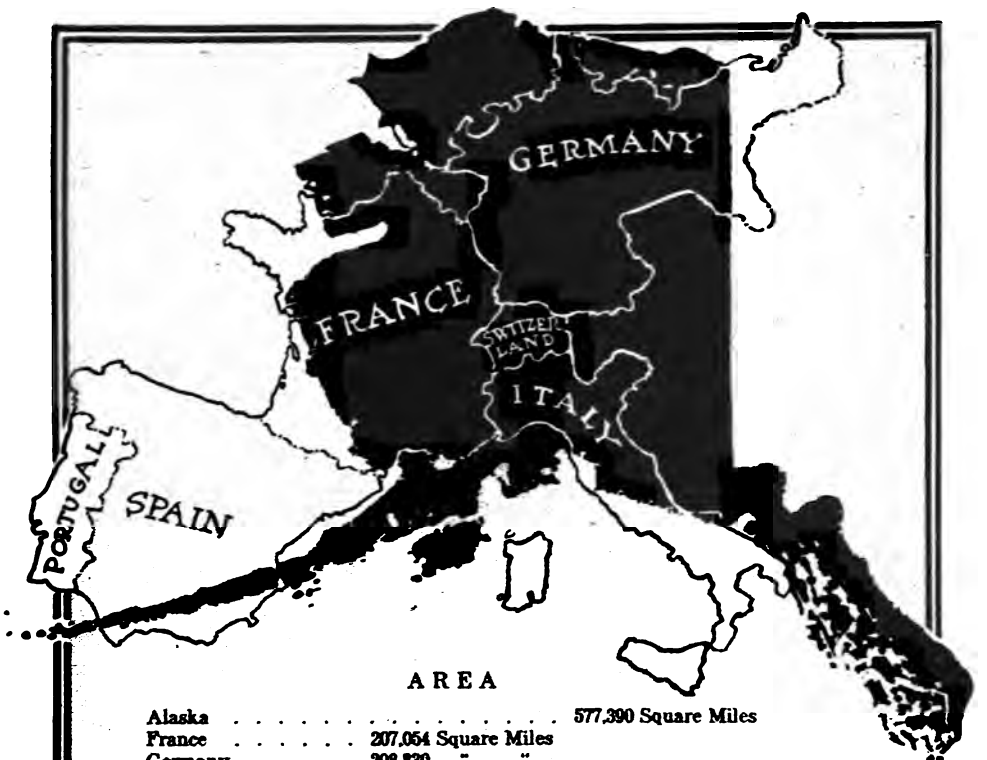
TWO MEN CAN CARRY THE WHOLE OUTFIT, INCLUDING AMMUNITION.

and it is claimed to be more perfect than that of any other machine gun yet invented. It is easily carried forward with the firing line, without exposing the operator to greater danger than an ordinary rifleman would experience. The rapidity with which it can be fired is astonishing. In one of the official tests made by the Ordnance Department, it discharged ninety bullets in fourteen seconds, distributing them over a bare space on a hillside about eighty by sixty yards in extent.

It is easy to imagine what deadly execution would be done under suitable circumstances in war, by a continuous stream of projectiles fired at such a rate and scattered as by the playing of a hose. The weapon, too, seems to be of great accuracy. In one test, where thirty shots were discharged in less than a minute at eight kneeling—dummy—figures, 300 yards range, fourteen hits were made. In other words, one bullet out of two, very nearly, either "killed" or "wounded" an adversary.

ONE MAN FIRES AND THE OTHER LOADS.

May
1910



AREA

Alaska					577,390	Square Miles
France	207,054	Square	Miles			
Germany	208,830	"	"			
Italy	110,550	"	"			
Portugal	35,490	"	"			
Switzerland	15,976	"	"		577,900	" "

TWENTY BILLIONS AT STAKE

The control of Alaska is the real issue in the Pinchot-Ballinger controversy.

Alaska is the richest undeveloped country in the world. There are already in sight gold, copper and coal deposits, alone, to the value of twenty billions of dollars. And only one per cent of the territory has been carefully surveyed.

This inconceivable wealth belongs to the people of the United States. Ballinger's policy would give it all, free of charge, to the Morgan-Guggenheim syndicate and other combinations of capital. Pinchot insists that at least a share of this public wealth should be turned into the public Treasury.

THE TECHNICAL WORLD MAGAZINE

VOLUME XIII MAY, 1910 NUMBER 3

ALASKA—THE NATION'S GOLD MINE

By

WALTER E. CLARK

GOVERNOR OF ALASKA

THE problems which occupy the minds of the people in Alaska are those which have to do with the development of natural resources. This convenient and mouth-filling phrase, descriptive of the greatest material things in our country, was a phrase of much significance in Alaska years ago—and the Territory is still young. There are political problems here, it is true; and there are social problems; questions of territorial government and municipal control; but they are all in a particularly intimate way connected with material development. There is no merchant who is not vitally and consciously interested in the development of mines; no mechanic who is not deeply concerned in the growth of fisheries and other industries; no citizen in any walk of life who is not eager to witness the utilization of the forests, of the water-powers and of the agricultural land. And, barring a few selfish individuals who are engaged in special enterprises which are not affected at all by prosperity or adversity in other lines of industry, every citizen is interested in some degree, directly or indirectly, in the promotion of every undertaking which makes for the material progress of the Territory—and is conscious of this interest.

Of course, our residents differ as to the means and methods of development and all are not ready at all times to encourage the others. There is some anxiety—so professed—regarding the operations of highly capitalized enterprises, and some fear lest equality of opportunity may not be afforded to the poor man. Sometimes it is feared that some particular enterprise will injure, through its natural operation, some other enterprise; but, broadly speaking, there is a well-recognized interdependence among the people, and there is certainly a remarkable feeling of optimism.

The world knows a good deal more about Alaska than it did ten years ago, but has much yet to learn. It is singular that the knowledge of Alaska's great resources has probably been spread on a larger scale within the last twelve months than in all the years that had elapsed since the Purchase; and that this knowledge has been promoted by persons whose first-hand information in the premises is slight. This enlightenment has been diffused through the medium of sensational newspapers and magazines —some of it highly inaccurate and mischievous; it has been spread by the apostles of conservation, big and little; but the world heretofore has been so little informed as to primary conditions in this Territory, and publicity is so welcome, that we cannot fail to give the

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muckraker his due. Earnest and sincere advocates of rational conservation, being engaged in a great work for the future of the race, will receive support in Alaska as elsewhere. It is unfortunate that the cause of conservation is so often exploited by sensational writers who, in their search for that which is evil, frequently ignore that which is good; or, without compunction declare that the good is really evil in disguise.

What are the leading facts about Alaska's natural resources? How are they being developed, and how shall they be developed? What are the opportunities for capital; what for labor? Is there equality of opportunity? What is the prospect for permanent settlement? How are the rights of the people to be conserved? I shall not answer all of these questions fully — some of them because I cannot, others because I may not with propriety while these matters are occupying the attention of Congress. We may, however, consider some of the more obvious facts and theories.

WALTER E. CLARK, GOVERNOR OF ALASKA.

Alaska is a big territory whose very bigness is only vaguely appreciated by persons at a distance, whose wealth of resources is just beginning to be recognized and whose climatic conditions have been misjudged and usually slandered. Alaska is as large as England, Scotland and Wales, France, Germany, and Italy combined. It has almost as wide a diversity of climate as is found among these countries, although the extremes of climate are not the same. After its acquisition by the United States in 1867, until 1884 it had no civil government, but was under the control of the military authorities. A civil judicial system was provided in the latter year, a governor and other civil officers being appointed. It was not until the late nineties that the value of the mineral resources was widely recognized, although the possibility of an enormous fishery industry had been appreciated for some years and the fisheries had undergone a considerable development. As late as 1905 the complaint that capital had failed to recognize the mineral and other great resources of the Territory, outside of the fisheries, was heard everywhere in Alaska. Even now there is an eager desire, almost universal, that capitalists enter the Alaska field; and not much honest fear that capital will "gobble up the country" and oppress the poor prospector and miner. The sane opinion is that capital can be properly controlled in Alaska; and there can be no doubt in any honest mind that capital is indispensable in a country as vast and isolated and rugged as this.

The salmon fisheries and one large gold quartz mine aside, the first significant embarkation of large capital in Alaska was about five years ago when the owners of a large copper mine in the Chitina region reached an agreement with some of the largest financial interests in New York by which a railroad should be built from the southern coast, somewhere near the mouth of the Copper River, for a distance of about one hundred and sixty miles to the interior.

ONE SOURCE OF THE GOLDEN STREAM.
Gold quartz mines in Silver Bow Basin.

It was understood also that in case certain interior copper prospects, still more remote from tidewater, should be developed the road would be extended. It should not be ignored that another railroad project, in the Resurrection Bay district, several hundred miles to the westward, had already been undertaken; but the enterprise had not been fully capitalized. Of this railroad, projected to extend three hundred miles or more to navigable water on the Tanana River, about sixty miles have been completed. The Copper River road is fully financed, one hundred miles of it have been completed, and the projectors expect to extend the line as far as the rich Chitina copper property by the end of this year or early in 1911. Without affirming that for these two railway projects routes have been selected which promise most for the permanent development and settlement of Alaska and for the welfare of the people, it is to be said that both promise much for the development of riches in certain regions. The older project—the line extending northward from Resurrection Bay—proposes to traverse a country rich in minerals and abundant in promise of agricultural development by a people of the hardier and more frugal classes. Gold and coal have appeared in good prospects, the latter being of good quality and abundant in the Matanuska region. Already there has been a considerable output of gold in the region tributary to the route of the railroad. The coal awaits the investment of capital, which, of course, is powerless to do anything until transportation is afforded. Referring to no railroad project in particular, but speaking generally, it may be said that the immediate investment value of railroads in Alaska may be questioned at this time; and this fact lends much soundness to the recommendation of President Taft that government aid be extended for the construction of railroads in Alaska, according to the plan adopted by the government for the Philippine Islands. By no other means, perhaps, will any railroad be built in the

THE TIDE-WATER TERMINAL OF THE ALASKA NORTHERN RAILWAY AT SEWARD.
When completed this line will pass through one of the most promising agricultural regions and the valuable Matanuska coal fields.

near future which will connect any Alaska seaport with navigable water in the interior, thus affording trunk-line transportation for passengers, mail and freight.

It is true in Alaska as it was true in the Western states some years ago that while railroad construction must, to a large extent, precede settlement and industrial development, this precedence is frequently accompanied by financial loss. The chance of ultimate success in Alaska seems no more doubtful or remote than it seemed in some of the far Western states fifty years ago. Nearly all of the early Western railroads received aid from the Federal government; similar aid, by all means, should be given in Alaska.

Of all the resources of Alaska, most of which will be assisted in development by the construction of railroads, minerals have attracted most attention, both from the public and from the government. The lure of gold exceeds that of any other enterprise in a new country; and the government, through the Geological Survey, has sought to inform the poor prospector and the rich investor and operator alike. The result in Alaska has been that survey parties have made reconnaissances and more detailed examinations of mineral deposits in this Territory every summer for many years. Not only the gold resources, but the resources of copper, coal and many other minerals have been sanely and accurately exploited by this agency of the government until nearly every locality in this vast domain has had the benefit of at least a general reconnaissance within the last decade. Valuable maps and reports have been published, and

A CENTER OF THE FISH INDUSTRY.
Petersburg, showing principal cannery buildings and a part of the town.

the more successful of the larger mine operators have invariably received some benefit from these, while all classes of miners and prospectors have profited according to their application and intelligence.

It is not possible within the small space of this article to discuss in great detail the mineral resources of a territory as extensive as Alaska. Such matter fills many volumes of government reports and is a part of the knowledge of the whole mining world. The prominent facts interest the whole public and stimulate the popular imagination. The prominent facts are these. Almost the whole southeastern part of the Territory, a region so mountainous and heavily wooded as to defy all except the more patient and resourceful prospectors, is a recognized mineral belt in which the most valuable known deposits are those of gold and copper. In the region roughly described as lying between Mt. St. Elias and the international boundary on the east, the Alaska Peninsula and Mt. McKinley on the west and the upper waters of the Tanana on the north, are found large deposits of copper, some gold —both quartz and placer—and some notably large bodies of coal.

The northern central and northwestern parts of Alaska are the principal regions of placer gold, and it must be expected that these regions will be the last to support anything like a permanent population. If a permanent population of any extent does find its abode in the northern central region it will be when, many years from now, agricultural settlement having become crowded in the southern valleys, hardy tillers of the soil seek residence in less favored locations to the northward.

BENEATH THE CLOUD OF SMOKE LIE THE SULZER COPPER MINES.
This wilderness scene is really a port on Prince Edward Island.

To go over the same ground a little more in detail, it is to be said that the coastal mountains of southeastern Alaska contain not only gold quartz and copper, but have shown also promising deposits of other minerals, both metallic and non-metallic, including more notably, galena, gypsum and marble. The world-famed

TWO HUNDRED BUSHELS OF POTATOES TO THE ACRE.
A market garden near Juneau.

Treadwell mines on Douglas Island have produced gold from quartz very steadily for many years, the present normal output being about $2,500,000 a year. It is the ambition of many a mining man to discover and develop "another Treadwell" in southeastern Alaska. Indicative of some promise in this direction is the uncovering of profitable gold ore in the Silver Bow Basin, near Juneau; on Chicagof Island, at Sheep Creek, at Eagle River, Berner's Bay and in several other localities. It is right to say that these discoveries are indicative, for the geologic nature of many other rocks in southeastern Alaska is essentially the same as in the localities where profitable mines already have been developed. But the country is of the most rugged character, and the last discoveries will certainly not be made for several generations to come.

When one considers the comparatively small actual production of gold in this part of the Territory outside of the Treadwell properties, it is well to make due allowance for the fact that litigation over claims and titles has been as prevalent as it has been expensive in southeastern Alaska, and that the disputes have retarded development in a marked degree. Very recently, there has been some appearance that one of the most important matters of litigation has been finally settled and that this settlement will open the way for a very large gold quartz development in the southeastern Alaska district. It is to be recalled also, that development of properties in the Silver Bow Basin has been exceedingly slow, by reason of litigation or insufficient capital or both; and that the Basin mines are now apparently on a better basis than ever before.

Copper production on Prince of Wales Island, also in this southeastern part of the Territory, had reached a profitable stage at several places in 1906, but there has been a general depression in that region during the last three years by reason of the lower market price of copper. Some of these mines have suspended shipment, for the ore, while abundant, is of low grade, and operation is either unprofitable or extremely hazardous in the present condition of the

market. There is some reason to believe that, even with copper at the present figure in the markets of the United States, mining on Prince of Wales Island, through new developments and through better methods of operation and treatment, will be restored to its former profitable basis.

It is significant that the largest marble quarry company in the United States has recently acquired some of the most promising deposits of marble in southeastern Alaska; and the indications are that these properties will be operated on a large scale. It may not be known generally that Alaska marble has already entered into the interior finish of handsome buildings in several cities.

Public interest in Alaska resources has recently been stimulated as never before because of the great controversy over the coal lands. The coal deposits around which the present public discussion is centered are those found in the Bering River field, only about twenty-five miles from tidewater, in the Controller Bay region. This field and the Matanuska field, north of Resurrection Bay, comprise at least 90 per cent. of the known bituminous and higher-grade coals of Alaska. At a time when discussion of conservation is active throughout the United States, it is not surprising that this coal field has become a subject of controversy, for it is a rich field, containing coal of a better quality than any other that has been found west of Pennsylvania.

The Bering River coal area covers, as the Geological Survey examinations show, 21.6 square miles of anthracite coal beds, and 22.7 square miles of semi-bituminous and semi-anthracite. The coal beds capable of being worked are generally from six to twenty-five feet in thickness, but much deeper bodies are found at intervals. We complete a rough inventory of these riches with the statement that "the coals vary from an anthracite, with 84 per cent. of fixed

IN THE FORESTED REGION OF SOUTHEASTERN ALASKA.
Plank roads are common in this part of the country.

ONLY ONE-HALF THE PRODUCT OF A SINGLE HAUL.
This scow has aboard eighteen thousand salmon.

carbon, to a semi-bituminous, with 72 per cent. of fixed carbon"; and that the field includes some coking coal. By far the greater part of this workable area has been located in many instances by poor men. Owing to early difficulties connected with the Alaska coal land law, and to the violent public controversy which was precipitated last summer, which is still in progress, no title has been granted to any claimant. It is unfortunate that this is so: the coal is needed for the uses of the people of Alaska and of the Pacific Coast of the United States. It is to be hoped that the danger of a coal monopoly, such as it is, will be overcome, and that the Bering River field, communication with which is about to be established by rail, may be opened to development in the near future. When it is considered, among other things that this coal is needed for smelting Alaska copper, and that the coal in question is of fine quality, the transcendent economic importance of this Bering River region becomes impressive.

The Matanuska field is almost as important, although not so near to tidewater. The nearest harbor open all the year, is on the eastern side of Kenai Peninsula, about 150 miles from the coal field. Knik Arm, only twenty-five miles from the coal deposits, is frozen during the winter months, and there is much shallow water between this point and the open ocean. Coal is found for a distance of from fifty to sixty miles along the Matanuska Valley. Some of this coal is hardly available for economical mining. The commercial coals vary from a sub-bituminous to a semi-bituminous. There is some evidence of a fair quality of anthracite; while, on the other hand, at one point at least, the coal runs into lignite, which is, of course, inferior in quality. These statements are made on the safe basis of some of the earlier examinations. It is becoming evident, however, that a very large amount of high-grade bituminous coal will be developed in this district. The beds range from five to thirty feet in thickness. The railroad projected several years ago from Resurrection Bay, and about sixty miles of which have been completed, has the Matanuska coal field as its immediate objective point. It is estimated that the coal-bearing area covers about 900 square miles, but the examinations are so incomplete that it is safe to say only that the commercial seams aggregate in area about fifty square miles. A good deal

INSIDE THE SALMON CANNERY AT FUNTER BAY.

of the best known coal-bearing land in the Matanuska Valley has been staked, but, as in the Bering River region, no patent has been granted. The situation is a little less critical, however, since the coal is more remote from tidewater, and the prospect of early railroad transportation is not as bright.

Other coal finds have been discovered in Alaska, but none as promising as the Bering River and the Matanuska. There are, however, large areas which are geologically almost unknown, and it is quite possible that the best and most abundant coals of the Territory have not yet been found.

Intimately related to the development of coal is the development of copper. Cheap coal means much to all copper mining in Alaska, and especially to the development of low-grade ores such as are found on Prince of Wales Island. These Island mines and prospects have been alluded to already. The one great developed body of copper ore which is awaiting transportation facilities in the Chitina region is of much higher grade than most of the ore heretofore uncovered on Prince of Wales Island. Many mining men believe that other large bodies of copper will be developed not only in the Chitina country, but in the White River and Nebesna River regions and in other localities whither the railroad now building may be extended. Henry Bratnober has said that the eastern central portion of Alaska is the richest copper region in the world. Other experts are almost as confident. It is to be admitted, however, that this opinion is seemingly based on no very thorough prospecting in this vast region, but rather on rich surface indications which cover a field remarkably wide. The prospects, at any rate, have satisfied a group of important financiers that an expenditure of probably not less than $20,000,000 in railroad building is justified. The best assurance which the people have that this great investment of capital in the country will not be used to oppress the poor prospector and miner and the independent mine operator is that railroad rates in Alaska, by a special act of Congress, are subject to regulation by the Federal government.

Before leaving the subject of Alaska mineral resources, I am constrained to revert to my former statement that it is impossible to cover so wide a field in detail within the limits of one article. I have selected the more significant economic features for a brief discussion.

Near the Bering River coal field there have been promising developments in petroleum, but here, as in the coal fields, it has been impossible to secure patents. There are other mineral developments which are also in their infancy. Recalling some of the older and successful activities in the mining field, it should not be forgotten that the placer gold mines, most of which are comprised in the north-central and northwestern parts of the Territory, are contributing from $12,000,000 to $15,000,000 per annum to the grand total of Alaska's production—a total which gives this Territory second place among all the States and Territories as a producer of gold. A good many areas have been "worked out," and discovery of new fields has not kept pace with operation in old fields during the last two or three years. The future of many placer fields is of interest chiefly for dredging and—where a sufficient water supply can be found—for hydraulic operation. The dredge is becoming very important in Alaska, as it has already become very important in the older placer fields of the Canadian Yukon. Equality of opportunity is not lost in Alaska, and will not be, but it must be admitted that mining conditions in many Alaska fields are such as to invite the capitalist and to discourage the operator of slender means.

Placer mines have never supported an abiding population in any country. They have sometimes attracted attention to other resources of the country. It was so in California, and so, I believe, despite the dissimilarity in climatic conditions, it will be in Alaska. Ten years ago, there were few persons, even in Alaska, who did not scout the possibilities of successful agriculture in Alaska. Even five years ago to exploit the idea of Alaska farms and gardens was usually to provoke jest among the new miners and even among the older residents of the territory. A great change has taken place. A few experimental gardens beside miners' cabins and on vacant ground

belonging to persons who live in the towns have produced vegetables and flowers of good quality—and a surprise for the cultivators. Nearly every kind of vegetable is now raised with much success in Alaska—even in localities north of the Arctic Circle. It has been found that the Tanana Valley, near the geographical center of Alaska, is potentially—and in some localities actually—a farming country. Fresh vegetables in the interior of Alaska, stored for use in the winter months, mean a good deal at a season when the country is snowbound and cheap transportation is wanting. The experiment stations of the Department of Agriculture have demonstrated many things about Alaska farming and gardening, but the residents have demonstrated for themselves still more. Barley and oats and wheat have been raised, although wheat raising is far from being a proved success. It is believed that a strain of wheat may be developed which will surely mature in certain favored regions.

In tillage of the soil such as has been attempted on a small scale in many widely separated localities in the Territory, it has been found invariably that productiveness improves after the first year of cultivation. The soil has laid dormant since the beginning of the world, and it is usually cold and "sour." It improves wonderfully with the mere turning over, without fertilization; and it produces wonderfully even where, in the northern regions, it overlies a sheet of perpetual frost. Of course, the almost constant sunshine of midsummer in the land of the midnight sun compensates largely for the shortness of the season. A few men are already making a livelihood by market gardening in the vicinity of some of the larger towns.

It is not claimed, withal, that farming in any part of Alaska offers any inducement comparable to that which is offered by lands in the great agricultural states in the West; but it does offer a livelihood in case markets are provided—and this usually means transportation. The Cook

BETTER THAN MANY OF OUR COUNTRY ROADS.
A government-built highway in Alaska.

Inlet region, tributary to the Matanuska coal fields, already alluded to, enjoys a comparatively mild climate with opportunities for agriculture in near proximity to gold and copper mines and to the fisheries. A hardy, persevering and frugal people will certainly subsist on the soil of Alaska in years to come. Men of the Scandinavian race are among the few pioneer homesteaders in the Territory.

The four great resources of Alaska are minerals, the agricultural soil, fish and timber. The world should know by this time that the salmon fisheries of the Territory produce annually about $10,000,000. With proper protection and replenishment of the salmon streams, this industry should endure. Other fisheries than those of salmon are in the very beginning of their development, and the wealth of these is enormous. The halibut fishery has reached large proportions. In 1908 fifty-one vessels and 395 men were engaged in the industry. The product of the industry was 5,662,006 pounds of halibut, nearly all of which was marketed as fresh fish. At the present time the halibut fisheries are being enlarged by the operations of a large Eastern corporation. Fresh halibut, both frozen and unfrozen, are shipped from Alaska by steamers to Vancouver and thence by express to the markets of Chicago, New York and Boston. The product of the Alaska cod fisheries is about equal to that of the halibut fisheries. The United States Fish Commission has accounted for the fact that the Alaska cod fisheries have not been developed on a still larger scale by this statement: "The prejudice in the Eastern markets against Pacific cod, traceable largely to the business jealousy of Eastern dealers, is rapidly wearing away as the excellent quality of the Western product is becoming better known." Most of the Alaska cod fisheries are along that part of the coast which lies between Resurrection Bay and Unalaska.

The king salmon industry, which employs a large number of men in catching and mild-curing these sterling food fishes largely for the German market, is increasing. Many other food fishes abound, and the supply of herring in southeastern Alaska is so abundant that one large company is engaged in catching them for conversion into fertilizer and oil. It is beyond the doubt of anyone that the fisheries form one of the four most valuable resources of Alaska, and that

THE TOWN OF CORDOVA WITH ITS HARBOR AND RAILWAY.
It has excellent transportation facilities.

ONE OF THE WORLD'S PRINCIPAL GOLD MINES.
The Treadwell group, Douglas Island.

the fishing industry promises permanent prosperity if it is properly conserved.

The timber resources of Alaska are not comparable to the magnificent forested areas of Washington and Oregon, but they are of great local economic importance. It is unlikely that large quantities of lumber will ever be exported from Alaska—at least, not if the fishing, mining and agricultural resources undergo the development which is expected of them. It is pretty generally known, probably, that the merchantable timber is confined largely to the southeastern part of the Territory, nearly all of which is heavily wooded; but large compact areas of big trees are seldom found, and much of the best standing timber is in places almost inaccessible. Yet it is possible to find some of the finest timber in Alaska that is to be found anywhere; and the Forest Service of the United States, possibly overestimating the danger of despoliation, has included four big wooded areas within the boundaries of national reserves. At first there was much complaint that these reserves would cause the development of the country to be retarded, but the Forest Service rules and regulations have been modified to suit local conditions to such an extent that the forest reserve administration is now accepted with more cheerfulness.

The reserves cover an aggregate area of 26,761,626 acres. Stumpage is charged on all cuttings, even of cord-wood. The receipts of the Forest Service in Alaska in the fiscal year 1909 were $13,488—representing a considerable lumber industry when it is considered that the greater part of these receipts was from stumpage at one dollar per thousand feet, board measure.

Nearly every cannery and mine in southeastern Alaska has its own sawmill. There is a large independent lumber industry at Ketchikan; and in nearly every town there is a mill which supplies local needs. The exportation of lumber from Alaska is forbidden by law, except in the case of lumber cut from the reserves and upon which stumpage is paid. Much of the smaller timber in the southeastern section will eventually be converted into wood pulp, in all probability.

In some parts of the interior of the Territory, also, there is standing timber to meet the local requirements of a large population in the future.

A survey of Alaska natural resources in every field gives a wonderful impression of the vastness of these riches. Only a glance is necessary to show that development everywhere is in its infancy; and a little more careful examination impels the conviction that, from the very nature of the conditions found in this truly magnificent country, development will be slow. It is a land of opportunity, but the opportunities do not "grow on trees"; and the chance of quick success is not notably greater here than elsewhere. Alaska is not an El Dorado, and there is found here no charm under the influence of which men grow rich without hard work. The various climates, although far less inhospitable than they are popularly reputed to be, are not ideal, but though rigorous everywhere, are nevertheless healthful. The summer season is short in the interior and northern regions, and the excessive rainfall of the lower coastal region impairs its advantages as a place of residence. And yet, these wonderful resources are surely being developed, and the imagination is fired by the prospect of enormous activities in the future. The abiding population of the Territory is increasing gradually; the people are just beginning to appreciate the possibilities of the soil as the source of support for permanent settlers. Old prospects have become successful demonstrations, and new prospects are constantly appearing. It is certainly not too much to expect that the achievements of the last decade—a period which we may define as one of education and exploitation—will be exceeded many fold in the course of the next ten years.

WIRELESS TELEPHONE WIZARDRY

By

WINSTON R. FARWELL

WIRELESS telephony is being developed at a rate that makes the plain citizen who aspires to be informed concerning the progress of the world hustle to keep up with the state of the art. Already A. Frederick Collins, the pioneer worker along this line has developed three distinct systems of wireless telephones, each adapted to a certain sphere of usefulness, each practicable and reliable, and goodness knows how many more he may turn out before the ink on these pages is dry.

The things that can be done with one or the other of these three systems would stagger the credulity of any but a people who by long familiarity with scientific marvels have become hardened thereto. It is now possible to talk without the use of wires with persons in distant parts of a building or in adjacent buildings regardless of the number and thickness of walls and floors intervening. One may take a wireless telephone on an automobile, a motor boat, a yacht, an airship or a submarine, into a caisson, a tunnel or a mine and be able to converse with others at any given point or points on the surface as freely and as plainly as one can now talk over a local telephone with nearby points.

It is even possible to combine the ordinary telephone with the wireless. Thus a telephone subscriber in Creston, Iowa, for instance, who wanted to talk with some one on board the *Deutschland* in mid-Atlantic need not be deterred by the fact that there was no wireless station at Creston. All he would have to do would be to call up Chicago on the long distance wire. Chicago would give the connection with the New York wire and

INVENTOR A. FREDERICK COLLINS TALKING OVER HIS LONG DISTANCE WIRELESS TELEPHONE.

the New York office would connect with the wireless station. The wireless operator, after calling the *Deutschland* by wireless, would connect the long distance wire from Creston with the wireless transmitter and the voice that had already traveled fourteen hundred miles overland by wire would project itself through the ether to the listening ear on shipboard on the lonely Atlantic.

In fact there seems to be few, if any, situations to which the wireless telephone is not adapted. In addition to the familiar daily use of the telephone the wireless will open up many new fields that cannot be occupied with pole and wire. Harbor craft, tugs and ferryboats can get into instantaneous communication with offices on shore and receive orders or changes in instructions while out on the water. When vessels are equipped with wireless telephones the pilot will be able to call up the pilot on another craft that persists in getting in his way and tell the offender privately what he thinks of him, his conduct and his ancestors instead of bawling his opinions out at an open window at the risk of having his license revoked by some horrified steamboat inspector. And when some badly rattled navigator betrays symptoms of intending to try to pass on both sides of another vessel at the same time the wireless telephone may be the means of saving both lives and property. The wireless telephone is the first notable improvement in marine signalling since the introduction of the steam whistle. Fogs, darkness and storms have no effect on the wireless telephone. And out in the country where subscribers are too few to warrant the installation of a wire system the wireless 'phone will afford a cheap and certain means of communication.

In the ordinary, every-day business of life the wireless 'phone has advantages over the more familiar system. When a message is transmitted over a wire a certain amount of electricity is required

to charge the wire before any words can be spoken. Under these conditions, however clear and distinct the words may be uttered, the longer the line the greater will be the distortion of the undulatory current until the words become so inarticulate they cannot be understood. But with the wireless, if the waves representing the voice are pure when they are emitted through the aerial wire they will carry clear and distinct the greatest distance the instrument is capable of propelling them. This is because the message is sent through ether, a medium which does not require to be electrically charged and which consequently does not distort the wave forms representing the voice. It would seem, therefore, that the wireless is the natural way for the transmission of messages while the wire line is the artificial way.

Another advantage the wireless 'phone has over the ordinary system is in calling. Instead of asking an operator at central to get a certain number for him the lucky possessor of a wireless 'phone can ring up his man instantaneously and talk directly with him. By means of disks with numbers on the edge, something like those used for the combinations of safes, the caller can tune his 'phone with a certain number in much the same way that the subscribers to the automatic telephone system in Chicago and elsewhere call a number through electrical selectors. By turning the disk to a certain number the particular 'phone wanted will respond, and no other.

Finally, the wireless is cheaper to install and maintain, for there is no costly copper wire and cedar poles to buy and set up and replace every time there is a little storm.

Now, do not get excited and conjure up visions of the Western Union Telegraph Company and Bell Telephone Company being driven into bankruptcy by the triumphal competition of the wireless 'phone while the stockholders therein haunt the bread line and the municipal lodging house, for nothing of the kind is likely to happen. At least, that is what Collins says. Being deliberate in speech Mr. Collins has time to edit his remarks as he goes along. The result is an estimate of his numerous inventions that has the ring of sound common sense. Here it is.

"It is not at all likely that the wireless telephone will take the place of the ordinary telephone—at least, in my lifetime, and I am only forty-one and a good life-insurance risk. You may remember the more enthusiastic prophets predicted when the Bell telephone was first brought out that it would put the telegraph companies out of business. Instead of that the demands upon the telegraph companies have enormously in-

WILLIAM JENNINGS BRYAN VARYING HIS WAY OF TALKING.
Using the Collins Wireless Telephone at Prescott, Arizona.

SHE CAN "ENTERTAIN" WITH MUSIC EVEN THOUGH AT A DISTANCE—

creased, while at the same time the telephone system has grown to vast proportions. Both combined have failed to prevent the volume of first class mail from doubling every few years.

"From these premises I draw the comforting conclusion that the world is progressing so rapidly that it needs all the means of communication that can possibly be provided. That is what has encouraged me to devote ten years of my life to the development of the wireless telephone. I do not expect even to affect the telephone system, but I feel confident of helping out by doing many things the ordinary telephone cannot do, for you see I can telephone without wires where it is impossible to telephone with wires."

One of the places where the wireless telephone will be particularly valuable will be in mines. Now, any one who wants telephone connection with the underground workings of a mine has only to string a wire down the shaft. But if there should be a fire or an explosion or if anything else should go wrong the frail wire would be cut off at the very time when the need of it was greatest. But portable conductivity wireless sets could be carried around anywhere by gangs of workmen. All they would need to do would be to drive an iron peg into the earth or rocks to make a ground contact and they would be in communication with the surface regardless of cave-ins, explosions, gas, flames or any other contingency. Many a life could be saved in mine disasters if the survivors only could communicate with the rescuing parties to direct their search. This conductivity wireless system has been tested up to a distance of three and a half miles and worked perfectly. It has been installed in a number of Western mines.

This ability to talk through miles of rock and earth rather staggers the credulity even of the layman who has

brought himself to believe in the wireless telegraph. It may be all right to send an electric impulse through the unobstructed air, but rocks and earth are so much more substantial that it would seem to be quite a different matter to pass any sort of impulse through them. But the explanation is very simple.

principle as those used in the ordinary telegraph are buried in moist earth at the surface station. A current, either direct or alternating, is sent through these base plates into the earth where it spreads in elliptic lines of force, like magnetic lines between the poles of a magnet, until they reach the receiving

—AND CARRY ON A CONVERSATION BETWEEN THE "NUMBERS."

Morse used the earth for the return circuit in the first form of electric communication given to the world. In other words, it has been known since the first practical application of electricity that the earth was a good electric conductor. In fact there are electric currents in the earth independent of any sent there by man. All Collins had to do, therefore, was to find a way to utilize the conductor already at hand. The task was not easy, but the application of the discovery is.

Ground plates on the same general plate down in the mine at any depth or distance.

Simpler yet is the inductivity method, which is limited to a few hundred feet, but which makes an ideal means of communication in office, factory, dwelling or warehouse. The apparatus consists, in addition to the usual transmitter and receiver, of a large primary coil of wire wrapped in insulating cloth until it looks like one of those hoops that children play with. At the receiving 'phone is a secondary coil of similar appearance. On

REVOLVING VARIABLE CONDENSER IN COLLINS' WIRELESS TELEPHONE.

speaking into the transmitter with a battery in series with the primary coil, an undulatory current rotating through the wire will set up a magnetic flow in concentric rings which keep spreading until they come in contact with the secondary coil. A more elaborate development of the inductivity apparatus is contained in a portable wooden case of about the size of an ordinary dress suit case. Within its distance limits the inductivity wireless, therefore, is about as convenient a means of communication as can be imagined.

Inventor Collins, however, is building his largest hopes on the third, or electric wave system. Whereas in the conductivity system energy decreases as the cube of the distance, in the electric wave system the energy decreases only as the square of the distance.

It should be borne in mind that wireless telephony is quite a different thing from wireless telegraphy; for in the latter an electric impulse of any character may be utilized as a signal, whereas in telephoning an alternating current having the same phase, amplitude and frequency at both sending and receiving stations is required. Thus electric waves produced by the disruptive discharge, which decrease very rapidly, dying out entirely in the very small fraction of a second, can not take the place of the long, smooth sine wave currents used in telephoning.

Beginning in 1899 Mr. Collins was able to telephone by the electric wave system no more than two hundred feet. A year later he had increased the distance to a mile; and by 1902 he was able to talk a distance of three miles. After a few more years he was able to talk from Newark to Philadelphia, a distance of eighty-one miles. Now he has reached a point where he expects to talk from New York to Chicago. The day may come when it will be possible to talk across the Atlantic, something more than twice the distance between these two cities.

VARIABLE TUNING TRANSFORMER.

One of the newest features developed, for which patents have just been issued, is a process by which the difficulty of tuning is overcome. By means of the new apparatus one circuit can be tuned with another automatically, thus rendering it possible for any telephone to call any other without any risk of interference by an outside party.

ADJUSTABLE TUNING AUTO-TRANSFORMER.

This particular type of wireless telephone was one of the features of the Alaska-Yukon-Pacific Exposition at Seattle last summer, where it won the gold medal, the highest award. Added interest is lent by the fact that plans are under consideration to equip all vessels in the United States navy with wireless telephones.

So far as outward appearances go the Collins electric wave wireless telephone resembles the ordinary telephone only in having the usual transmitter and receiver. The rest is strange.

One of the most weirdly spectacular features of telharmonic music produced by that wonderful electrical musical instrument invented by a Massachusetts doctor a few years ago, was the possibility of delivering music and light at the same time through the same arc lamp. The Collins wireless telephone is suggestive of telharmonic music in the fact that you talk through an arc light. This arc lamp, however, is fundamentally different from the ordinary kind as seen on the street. The latter may do to deliver

music in plain air at short range; but when it comes to transmitting the human voice, which is rarely musical, long distances through ether, which is fifteen trillion times lighter than air, so light in fact that a ball of it the size of the earth weighs only two hundred and fifty pounds, at the rate of one hundred and sixty-eight thousand miles a second, something very special in the line of arc lamps is required.

In the Collins "revolving oscillation arc lamp" the carbons are disks instead of pencils, and they revolve at very high speeds in opposite directions. This is to prevent them from burning unevenly as ordinary carbons do, which would throw the circuits out of resonance and make talking impossible, and also to produce a longer arc than is possible with ordinary carbons. The carbons are enclosed in a casing which is supported between the poles of an electro-magnet. Through the ends of the poles of this magnet and at right angles to them are polar projections of soft iron threaded and screwed through the extremities of the magnet at right angles to the arc, thus permitting the magnetic field to be varied within wide limits. The coils of the magnet are used as a portion of the primary circuit of the transmitter, serving the purpose of choke coils to prevent the oscillations from backing up into the high tension direct current generator. The current is also very different from that used in the ordinary arc light, for it is received as a direct current of five hundred volts by a direct connected motor generator set and stepped up to five thousand volts before it is used to energize the lamp.

Other apparatus consists of an inductance transformer by means of which the telephone transmitter is tuned. In outward appearance it is a cylinder about two feet long, consisting of a solid core wound with wire surrounded by a spiral ring. On the base is a little track on which a carriage runs on which are three small grooved pulleys that are held in contact with the spiral ring. When the ring is revolved it causes the carriage to travel back and forth, thus increasing or decreasing the inductance, in order to get the closed oscillating circuit in resonance with the open radiating circuit.

SENDING A WIRELESS MESSAGE WITH A PORTABLE INDUCTIVITY SET.

The tuning auto transformer used in the aerial wire circuit is another large wire-wound core with a screw mounted on top with a wheel at the end. By turning the wheel the contact spring is made to travel back and forth. The variable condenser consists of a number of semi-circular fixed plates of metal insulated in a cylinder filled with oil with a series of movable plates meshed with, but insulated by the oil from, the stationary set. A handle attached to the rod permits any variation of capacity within the limits of the condenser.

The receptor includes a thermo-electric detector, the principal features of which are two exceedingly fine wires of different metals crossed at right angles

and forming a couple. Under the junction of these wires is placed a resistance wire which is heated by the currents surging in the aerial system. This detector is exceedingly sensitive. As the electricians put it, it is sensitive to the five-thousandth of an erg, which means in plain English that it is sensitive enough to pick up all the varying inflections of the human voice.

The highest degree of tuning is obtained by a thermo-galvanometer, which consists of a single loop of silver wire suspended between the poles of a permanent magnet. The lower ends of the loop are connected with a bismuth-antimony thermo-couple which is heated by a fine filament of high specific resistance, through which the oscillating current passes. One end of the heater is connected with the frame of the instrument. The heat generated falls on the thermo-junction and the resulting electro-motive force applied to the ends of the silver loop causes it to turn in the magnet field.

HOW TO SLEEP OUT DOORS

By

BAILEY MILLARD

IF you want a good object lesson in what indoor living and indoor complaints mean to natural animal life, take one of our wild, free, hairy forbears, fresh from the jungle, and put him in the house for a while. The stale air, the lack of sunlight, the stove or furnace heat will soon reveal themselves as enemies of life. Within a few months, under such conditions, monkeys nearly always droop, sicken, curl up and die.

In modern houses Indians contract all kinds of ailments, and that is one reason why they are passing away so rapidly.

Now we are neither monkeys nor Indians, but we partake largely of the natures of those beings, and we can endure a certain shutting-in and no more. As civilized beings we used to have far less of this shutting-in than we have nowadays. Over sixty per cent of our population now lives in cities, which means that for about twenty-two hours out of the twenty-four that urban proportion of us is reaping the results of indoor sedentary life. In many instances these results are poor blood, loss of vitality, puny offspring and the slow but sure degeneration of the race. Our cities are still young. If one goes to the older European capitals one finds sad conditions, mainly the result of the over-sheltered life, though excessive drink and poor food also play their parts. The history of London's race of weaklings will be our history unless something happen to prevent it, for we have drifted far away from the days when the greater number of our people lived the rigorous farm life and when red-apple-cheeked boys and girls were the rule and not the exception.

How are we to offset the effects of the shut-in life? How are we to overcome the modern tendency toward indoor disease?

So obvious is the answer to that question that it seems equivalent to asking why people eat or sleep. It seems a cheap superfluity to say, "Go out of doors, get the fresh air and the sunshine and sleep in the open whenever you can." Yes, that admonition is altogether too cheap. It is only when a physician makes a charge of from ten to one hundred dollars for just such advice that most of us are ready to heed it. Things that cost nothing are not popular.

Therefore, dear indoor reader, consider yourself taxed a thousand dollars

NO SPRINGS IN THIS GRANITE MATTRESS WHICH KEEPS WARM ALL NIGHT FROM THE SUN'S STORED-UP HEAT.

for this preachment of mine upon outdoor sleeping. When sermons come that high you are going to listen to them even more carefully than you do to such sermons as "The Servant in the House" or "The Passing of the Third Floor Back," for which you buy two-dollar seats in the dress-circle.

One chilly evening up at Lake Hopatcong, in the New Jersey highlands, a number of people were lolling about in the hotel sitting-room before a big blaz-

WHEN THE EARLY MORNING SUN STEALS INTO THE OUTDOOR BEDROOM.

ing log fire. Edwin Markham, author of "The Man with the Hoe," was there, talking poetry with some literary-minded new-comers.

"Well, it's about bedtime," said one pale city man, "and a mighty cold night, too. This is the kind of night when I pity those who have to sleep outside."

"Pity me then," said Markham.

"Why so?" said the man curiously. "You don't have to sleep out, do you, Mr. Markham?"

"No; I don't have to," was the poet's quiet reply. "But I *do*." Then he explained that during his annual six months' stay up at the lake he always slept out on the open veranda of his cottage, no matter what the weather.

"Quite a good many do that nowadays, you know," said Markham. "It seems that people are just beginning to discover that they have lungs and that their lungs have to be fed as well as their stomachs."

Yes, a good many people are discovering that it pays to sleep out of doors, and the pity of it is that so many have waited until they have no lungs to speak of before making the discovery. But now in this year nineteen hundred and ten there is what I came near calling a wave of interest in outdoor sleeping, but perhaps it may be only a wavelet. In certain communities this wavelet has rolled up into a sort of fad, and it is spreading out and rolling higher month by month, so that in the course of time it will doubtless become a strong, husky breaker that shall sweep away our indoor maladies. For where outdoor sleeping has once become a fad it soon becomes a fixed habit. No one who has thoroughly enjoyed his bed in the open, night after night and summer and winter, ever willingly relinquishes it and is generally eager to get back to it. And here are some of the reasons:

The sweet feeling of naturalness and bodily well-being.

Freedom from insomnia, for which outdoor sleeping is an absolute specific.

The wonderfully recuperative and vi-

talizing processes of which one quickly reaps the benefit, even though at first badly run down in physique.

The consciousness of escape from conditions that hamper if they do not actually threaten human life.

Immunity from colds and the diseases they engender.

As to colds, let me relate the experience of John Muir, the old naturalist and mountain guide who conducted Roosevelt and Taft on their journeys through the Sierras.

Muir contracted bronchitis. After coughing about the house for a while he announced to his wife that he was going glacier-climbing in Alaska.

"Not in your condition, John," protested Mrs. Muir.

"Yes, in my condition," he declared stubbornly. "There's nothing quite so good for bronchitis as to sleep out on a nice, big, wet glacier."

He went to the glacier country and camped out just as he had promised himself, and within a week his bronchitis was gone.

Nearly forty years ago Emerson's traveling companions refused to let him spend a night out of doors with Muir in the Big Trees of the Sierras for fear he would catch cold. But today they would hardly hesitate, for the world has added to its wisdom the knowledge that sleeping out of doors, so far from being dangerous, is probably the only really safe way after all.

AN IDEA WHITE MEN MIGHT BORROW TO ADVANTAGE.
A native Arizonian sleeping out of doors.

THIS HEALTHY LITTLE TWO-YEAR-OLD NEVER SLEPT INDOORS.

To be sure those faddists who live luxuriously on seven walnuts a day and who take up everything new as it comes along have caused the term "outdoor sleeping" to raise a smile on occasion because of their piquant processes; but though I may mention some extreme examples, I shall urge only rational methods.

Now before we get too far away from that bugbear of catching cold out of doors permit me to add my mite of evidence. I have slept out on the mountains, in the desert, on the seashore and on the ocean. Once in the Oregon mountains I slept in a single blanket in the snow and again, without a blanket, on a big rock in Wyoming where the nights are always chilly; but in none of these instances have I ever caught cold. Where one has sufficient bedclothing there is not the slightest danger from this cause when lying out of doors with the temperature at or below zero.

While many persons wait until they are actually ill before venturing upon a

THE REAL WAY TO SLEEP OUT DOORS.

course of outdoor sleeping there are many others who do so from actual choice though they are fairly healthy. Among these latter one will find the happiest people in the world—happiest because their nerves are steadiest, because they have more physical resistance to heat and cold and, most of all, because night after night they revel in that large elemental joy, that real animal content, which the shepherds of the hills know when they lie down beside their flocks.

No one better understood the joys of the bed in the open than Robert Louis Stevenson. Of one night in the Upper Gevandan he says: "I have not often enjoyed a more serene possession of myself. The outer world, from which we cower into our houses, seemed after all a gentle, habitable place; and night after night a man's bed, it seemed, was laid and waiting for him in the fields where God keeps open house."

But all things in life are relative, and while there are pleasant places to sleep in there are also unpleasant ones. For example, there is nothing that looks more inviting to a camper than the soft sands of the seashore. Here, he thinks, he will lie down on the smooth, comfortable bed of the beach and be lulled to sleep by the wash of the waves. Not so. What soon destroys all the poetry of this idea is that it is almost as easy to lie out all night on a pile of cobblestones as it is upon the beach. I have tried it several times and always with the same result, namely, that the sand would first open and I would settle half-way down into it, then it would slowly close in about me, stopping my circulation. This, even though I had a thick blanket under me. But one summer, when I slept for two weeks upon a cot by the Bering Sea in Alaska, I thought I had never enjoyed so delightful an outing experience.

The best of outdoor beds is an evenly laid pile of balsam boughs. Fragrant they are and comforting to the sense and they are much softer and springier than the branches of cedar or tamarack trees.

In a village of about fifteen hundred inhabitants near my home town there are ten persons that sleep out of doors winter and summer. Among them is a real estate man, his wife and two-year-old child. They are not invalids, but strong persons capable of much physical resistance. The man and wife sleep in a bed upon a balcony overlooking the Hudson, and the child, who has never slept indoors, lies in a crib beside them.

"At first," said the head of the family to me, "it seemed strange to wake up of a winter morning and look down upon the river full of floating ice and to see the snow lying deep upon the top of the cliff. But soon I got used to it, and suffered no discomfort of any sort. But whenever I travel and have to sleep in a hotel bedroom or in a Pullman car I find it uncomfortable indeed."

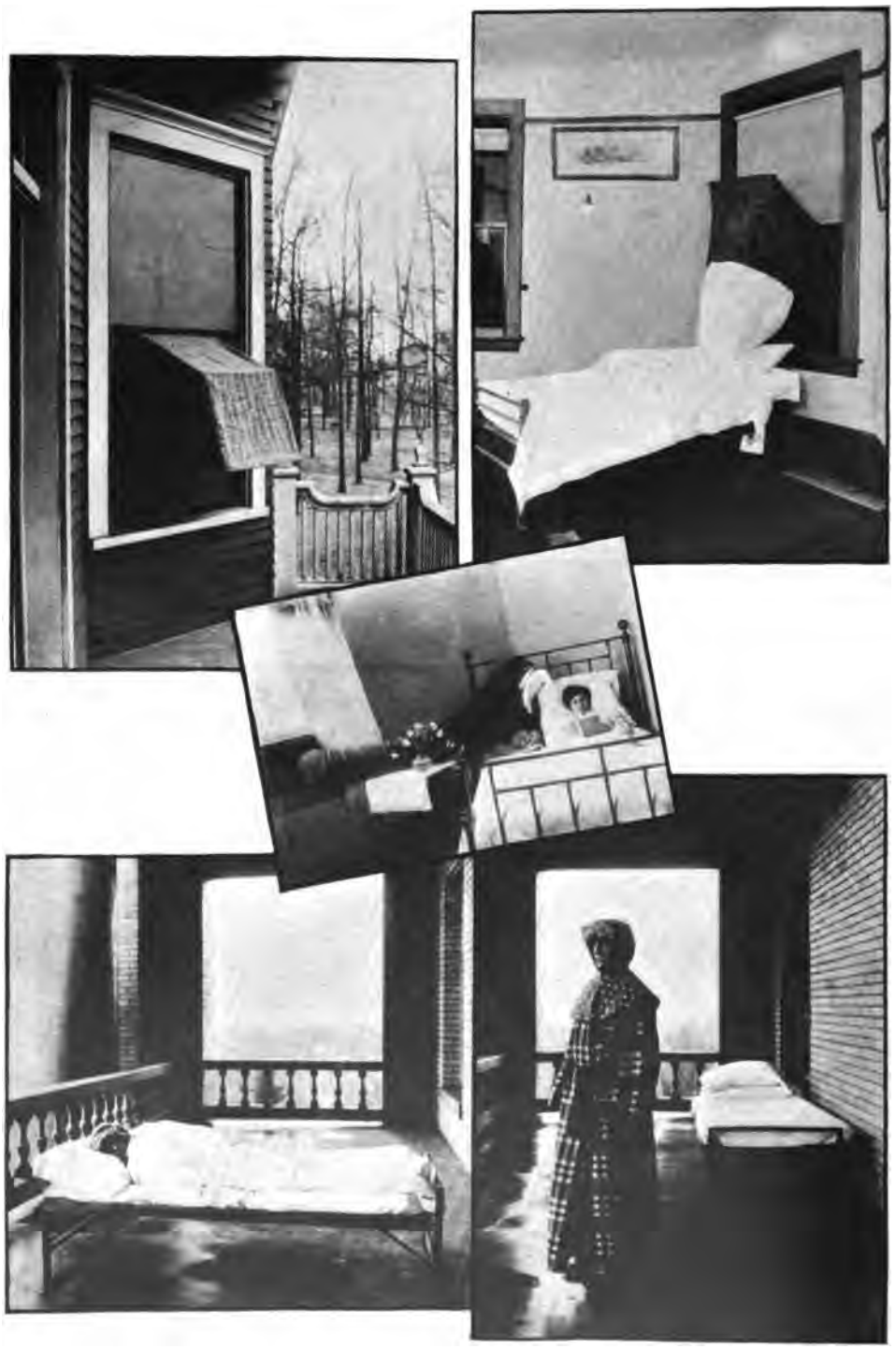
Sleeping balconies are easily arranged. For $200 or $300 you may build an upper story on your back porch, roof it over, screen the sides and have canvas curtains to let down when it rains or blows too hard. Most sleeping balconies are boarded up all around about three feet from the floor, so as to shut out the view of one's airy bed from the window across the way. The dressing and undressing are usually done in an inside room, so as not to make them a neighborhood affair, and also to prevent undue exposure to cold in the winter time.

Those who have sought to cut down the expenses of their sleeping balconies have in some cases made them just large enough for the bed into which they crawl from a door or window, and still others have resorted to a device known as a window tent, which is so arranged that the bed may sit beside an open window and the upper part of the couch be covered by the tent which fits tightly against the casement at one end and does not admit the cold air to the rest of the bedroom. In this way many sleep out of doors in their own bedchambers and get the full benefit of the pure outside air summer and winter.

Fresh-air tubes running from the window to the head of the bed and fitting tightly down all about it, are also employed. These tubes are of canvas and are about the diameter of an apple-barrel. They may be made of a length to admit of placing the bed in any desired position in the room.

The window tents and tubes are easily constructed by any amateur carpenter who can stretch canvas over a wooden frame and tack it down, and it is sur-

GOOD USE OF A SLEEPING BAG ON THE VERANDA.



SLEEPING OUT DOORS IN YOUR OWN HOME.

These illustrations show a window tent, outside view; inside view of the same; air tube for inside sleeping; sleeper on balcony; and a cold weather sleeping rig.

prising that, considering their cheapness, more run-down, nervous people do not avail themselves of this opportunity for vital renovation and recuperation. For the nerves there is nothing like the open air, especially the cold air of winter, which all medical men agree is the best tonic known and the most powerful of all tissue-building agents.

But it is very important that the body of the open air sleeper should always be kept warm.

"The first essential," said a lady of my acquaintance who has slept for five years in the open air on a balcony at her home in our village, "is to have several woolen blankets over the mattress. I never use cotton sheets in cold weather," said she. "I don't use a very heavy covering, three or four light-weight blankets being sufficient in winter. The nightgown or pajamas must be woolen and over that I pull on an eider-down robe with a large hood which comes down low upon my forehead. Loose knitted socks and, in very cold weather, a large hot-water bottle, complete the arrangements for being as comfortable as in a heated room."

Another woman who lives in the same village slept out upon a large open veranda all last autumn and winter. The veranda was latticed save for four large openings and was provided with storm curtains. This woman was troubled with insomnia before she began to sleep out of doors.

"Now," she says, "I sleep soundly all night and am never awakened by the barking of dogs or by early rising chickens. My physical resistance is greater. I don't feel cold in houses where other people shiver. So great is the pleasure of my outdoor nights that I could not be hired under any consideration to sleep in a house."

It is difficult to make application of the various outside sleeping devices to the city home unless a family has a whole house to itself. But apartment-house landlords make no objections to window tents, provided they are not on the fronts of houses. As a rule, window tents are all that the open air sleeper of the city can employ for his purpose, as the fire ordinances of most large towns will not permit roof tents save in isolated places, and no sleeping is allowed upon fire-escapes. Where a roof shack is permitted, it can be built with lattices or screens or wide-open spaces, properly provided with curtains to protect against wind and storm.

One objection to a window tent in an apartment house is that an early-rising boy, with a turnip or a potato, can make things very unpleasant for the person under it, but where obviousness or queerness of exterior effect is avoided this is not likely to occur. A window tent may be screened by a common covering, or it may be made to look like one, and then there is no potato temptation to overcome the small boy.

All last summer I slept out of doors on the shore of Puget Sound, in the state of Washington where there is plenty of rain; but, under cover of a good broad sheet of canvas, I did not get wet and was never so cold in the morning that I could not thoroughly enjoy a plunge into the salt water before sitting down to breakfast with an excellent appetite.

In raw or wet weather some sort of shelter is necessary in a camp, as even the most enthusiastic camper will admit. But it will be surprising to many to learn how small and light this shelter may be. I have traveled over the Dakota plains with my house in my hand, as it were, my entire outfit consisting of a small bag and a shawl-strap parcel, weighing only nineteen pounds. The parcel contained a warm woolen blanket and a five-by-seven "silk" tent. The tent was coated with paraffine and was absolutely water-tight. Thus I was well protected against the elements. Free ventilation was secured by slits in the front and rear walls near the ground.

But most enjoyable of all experiences of this sort is to crawl into one's sleeping bag and lie out on the good gray earth under the friendly stars. Stars are the best of company and one never tires of them. It is not necessary on your part to say a word, but simply to lie there and enjoy their bright eloquence while you grow drowsier and drowsier and the night breeze lulls you into a most blissful slumber.

My experience, as well as that of nearly every other outdoor sleeper that I have met, proves one fact conclusively:

VARIOUS ARRANGEMENTS FOR SECURING FRESH AIR WHILE SLUMBERING.

These photographs show the outside and the inside of a model sleeping balcony, and the best way to ventilate a tent.

The number of indoor sleeping hours can be cut in two by the outdoor slumberer without ill-effects, and no one who sleeps afield ever requires in one night more than six or seven hours of tired Nature's sweet restorer, unless he has been sleep-starved before hand.

Summer, of course, is the ideal time for sleeping out of doors, and this summer as many of us as can do so should lie out every night and look up at the stars and get some of that large inspiration which is denied to us in the stale air, the heat and the dust of rooms.

A LONG LOOK FOR WATER

By

CHARLTON LAWRENCE EDHOLM

TO what lengths will not a man go for water! The picture of the wanderers in the desert gasping their life away between the parched earth and the pitiless sky, the old sea tales of shipwrecked sailors on the raft, perishing with thirst yet unable to drink, how vividly they make us realize that water is more precious than diamonds or gold, that water is life itself. And what the full canteen is to the prospector in a thirsty land, just that is an abundant water supply to a city.

Out in the southwestern corner of our country we have seen a city of a third of a million people whose future growth was seriously menaced by a foreseen lack of water to provide for its constantly increasing population.

A few years ago, Los Angeles was brought face to face with the biggest problem of its existence. The engineers of its municipal water system were able to report accurately the number of people which that limited system could sustain, and some of the very best engineering talent in the country set to work to solve that problem. Water must be had at any price. Like our desert prospector, the engineers looked about for the nearest available supply. As they would say out in the range, "It was a long look,"—about two hundred and fifty miles. That was where they had to go for sufficient water to sustain the future population of Los Angeles. And the quarter of a thousand miles, or thereabouts, extended over a country, the desolation of which cannot be realized by a man who has not known the desert. Leagues and leagues of barren, wind-driven sands of the Mojave must be crossed, canyons deep and wide must be leaped with flumes or linked with siphons, and mountains must be bored with tunnels whose length aggregate thirty-eight and a half miles, the greatest of them being of a length of 26,860 feet. And all along this two hundred and fifty miles there must be a gradual down grade except at certain points where there is a direct fall of hundreds of feet, for in no part of its course does the aqueduct depend on a pumping plant, but from the Owens River to the city of Los Angeles the waters of the Sierras are to flow by their own weight.

This undertaking is an engineering feat which is claimed to be second only to the Panama Canal project in the magnitude of its operations and the difficulties which must be surmounted. It is a great city's struggle for existence, for when a city ceases to grow it ceases to exist.

To one who has an eye for such things there is an element of romance about this big undertaking that seems to outweigh even the significance of the statistics, appalling arrays of numerals and ciphers, which convey little to the average mind. Of what interest is it to us that this aqueduct will deliver between

A LINK IN THE GREAT WATER ROUTE.
At the mouth of the Whitney siphon.

two hundred and fifty and three hundred million gallons per day, that the cost will be twenty-four and a half million dollars, that the work will require over a million barrels of cement and more than twenty-three million pounds of steel, compared with the fact that the man whose brain directs the work was once a common seaman and later a cleaner of ditches in the water system of which he is now the head? That is William Mulholland, Chief Engineer of the aqueduct. How much less does it stimulate the imagination to be told that eight and a half million cubic yards of loose earth must be excavated together with one million and more cubic yards of rock than to learn that the man whose mind first conceived the idea of diverting the waters of the Owens River was once a rancher upon its banks? That is Fred Eaton, who was one time city engineer and afterwards mayor of Los Angeles. And how much of the story will never be told, that part of the story which has the greatest element of human interest, the plans and struggles to make an idea which men laughed at as impossible, while, preposterous, a solid and indisputable fact? And the plots and counterplots involved in the preliminaries in this plan, the secret purchase of land and water rights, the careful guarding of a secret? For if it were disclosed at that stage of the game that titles along the proposed right of way were being bought for that purpose, it would have meant that land speculators would have stepped in between the owners and the city, and by their greed would have robbed the people

THE FOUNDATION BLOCKS FOR THE SIPHON LOOK LIKE TWO ROWS OF TOMBSTONES.

of millions, or even made the project impossible. Of these things we shall learn little unless the great silent men who *do* things become reminiscent.

But, meanwhile, the big fact in itself has a romance that attaches to all great things, the Sphinx, the Pyramids, the Colosseum and, for our grandchildren, the skyscraper. To turn aside the waters of a river nearly four thousand feet above the sea and send it gushing and hurtling through the mountains and across the deserts to a waiting city, to miles upon miles of land that yearn for its fertilizing embrace, seems not merely a feat of engineering skill but a god-like gift of life. The details of construction are forgotten momentarily at the thought of a deed which the Greeks might have made immortal by some tale of a young god imprisoned in the mountains who being set free by pigmies delving in the earth, rushes down to clasp his bride, the broad, virgin acres, and how, in his gratitude, he blessed the race which had set him free, and made them the heirs of untold riches.

Away up in the Sierras, 12,000 feet above sea level, the waters have their origin in numerous streams that find their way to the Owens River in the valley. The waters of the river are diverted about thirty-five miles above Owens Lake by an open canal, through the valley and carried along the Alabama Hills around and above their natural reservoir, the brackish lake, a body of water which has no outlet.

The work for the first twenty miles from the intake is done by two suction dredges which make use of the principle involved in hydraulic mining, cutting away the banks by means of a hose. This part of the aqueduct is a canal about sixty feet long. Beyond this point to the Haiwee Reservoir, steam shovels will do the work. At the Haiwee Reservoir is a power drop which will develop a great amount of electric energy. Below this drop is about fifteen miles of comparatively easy digging and, going on the principle of getting the hard work done first, the activities of the construction force are concentrated on the following divisions, where tunnels, flumes and siphons are required.

Just before plunging into the Mojave Desert there is an especially rugged country to be crossed and bored. The Jawbone Canyon will require a huge siphon composed of steel pipe, eight feet in diameter at the lowest point and

ONE OF THE SOURCES OF LOS ANGELES' WATER SUPPLY.

LOS ANGELES BOARD OF ENGINEERS WHO PUT THROUGH THE AQUEDUCT PROJECT.
From left to right: William Mulholland, Fred Eaton, J. B. Lippincott.

about ten feet at the highest points. Then come miles and miles of tunnels, flumes and more tunnels. The traveler by train on the branch line from Mojave, known as the Sage-Brush Special, can see a line along the mountains, quite as straight as if it had been drawn by a gigantic ruler upon a flat, painted background. Where this line is broken, it has merely pierced some spur of the range, and where it is visible he can trace it to a point where the steam shovel is tirelessly cutting and cutting the great trench.

At Mojave the main line of the Southern Pacific crosses the aqueduct, and there the traveler will see the covered conduit with its upright projecting ribs to add strength to the cover. With a very practical sense of the value of advertising — a characteristic of Los Angeles, by the way —the officials have placed a sign at this point stating that it is a part of the Los Angeles Aqueduct. It is not "the Los Angeles way" to hide its light under a bushel. Here the railroad passes one of the big construction camps; quite a fair-sized town, it is, laid out with military precision with field hospital, commissary and all that is required for the comfort of the laborers.

It is interesting to note that the estimates for the conduit in the Mojave division did not include the cover of concrete and twisted rods, but merely provided for a trench lined with concrete. So well have the engineers kept within their estimate, however, that they will be able to provide the eight-and-a-half by twelve-and-a-half foot conduit with a cover, and yet expend no more than the amount originally called for.

THE WHITNEY SIPHON.
Showing tunnel exit on hill.

After crossing about thirty miles of the Mojave Desert, the aqueduct once more enters the hilly country of the Antelope and Elizabeth divisions, in the latter of which is located the great five-mile tunnel and the second power drop, there being a fall of something more

A STEAM SHOVEL CUTTING OUT THE PATH FOR THE AQUEDUCT.

HYDRAULIC DREDGE BEGINNING THE WORK NEAR THE INTAKE, OWENS VALLEY.

HERE THE DREDGE HAS BIT OUT A WATERWAY SEVENTY-EIGHT FEET WIDE.

than a thousand feet in the Elizabeth division.

The third power drop brings us into another hilly country, with tunnel after tunnel, two siphons and three reservoirs, the lowest of which is an elevation above sea level of a little more than eleven hundred feet. From this reservoir, the San Fernando No. 2, the distributing system of the city water works will carry the water into Los Angeles.

Such is the very briefest survey of the course of the world's longest aqueduct. It hardly hints at the difficulties encountered and overcome. For three years the details of this work were planned out, and such great foresight was used that there has been no hitch in the work, no costly waiting to rectify mistakes, but every detail has dovetailed smoothly. Although in the preliminary work there were parts of the country which had to be crossed that were too rugged for even the sure-footed little burros, yet the

ROOFING OVER THE CONDUIT.

road-builder and the caterpillar traction engine which finds its own roads, and the steam railroad were pressed into service. The Southern Pacific has projected a branch line from Mojave to parallel the aqueduct, and a large part of the distance from Mojave to the intake is already constructed.

selves, to say nothing of the cement mill with its capacity of a thousand barrels of cement a day.

The plant and the town site of Monolith, on the Southern Pacific railroad near the Tehachapi Pass, are owned by Los Angeles. The city is the owner of a valuable clay deposit about a mile from

A CAMP OF THE ENGINEERS IN THE MOUNTAINS.

In telling about the details of the aqueduct work it is difficult to know where to begin and where to stop. The municipal power plants, which operate the dredges and supply power all along the line; the telegraph and telephone systems, which connect every camp with the headquarters in a big Los Angeles office building; the arrangements for housing and caring for the laborers; all these are big enough for articles in themthe plant, and of three limestone quarries about five or six miles distant in the opposite direction. The clay is scooped from the lake bed by means of a dredge operating an "orange peel" bucket, the bucket or scoop resembling the four sections of a quartered orange. An aerial tramway carries the clay to the mill across the Southern Pacific tracks. From the quarries, the limestone is conveyed by a municipally-owned railway to

HAULING CONCRETE MATERIAL ACROSS THE CALIFORNIA DESERT.

the mill, where it is crushed and ground, mixed with pulverized clay and burned in the immense revolving kilns. This is said to be the only municipally-owned cement plant in the world. In fact, Los Angeles is setting a pace in municipal ownership which makes it possible to discuss that condition, not as a theory but a well-tried fact.

In the first place, Los Angeles owns its water system; not anything very wonderful in that, although some cities are still groaning under the despotism of a few "water-barons" who check the growth of such communities by excessive taxation. But here is a city which, having once come into possession of its water system, not only fosters the growth of the community by reasonable water rates, but shows a wonderful foresight in providing for the future metropolis of the Southwest; such foresight and executive ability as is attributed only to a genius of high finance, the kind of a man who—so the opponents of municipal ownership say—cannot be induced to work for the benefit of the people, but only for his own enrichment.

That argument is now upset. Some of the best brains in the country are in the service of Los Angeles in its aqueduct project.

AERIAL TRAMWAY DELIVERING MATERIAL AT THE CEMENT PLANT.

The hardest kind of political campaigning was needed to get the project well under way. The people had to be educated to vote with intelligence on the bond proposition. The obstacles were interposed by certain "interests" in the state legislature, which required keen brains to circumvent. Influence was also brought to bear at Washington, with the result that free right of way was granted through government lands.

The expenditure of the twenty-three million dollar bond issue requires the highest financial and executive ability. Part of the bonds were first put on the market during the late panic and, to avoid paying unnecessary interest, only such amounts as may be required are sold from time to time. The safeguarding of this huge bond issue of twenty-three million dollars from

grafting politicians was a part of the work in which the people took a hand. The appointment of a man with an unsavory political record to sit on the board which expended this money was cause enough for the overthrow of the administration responsible for the undesirable appointee. The recall was invoked and the entire city government thoroughly purged. But that is another story, and a big one.

Against the men who are directing this work there has been, as I said before, not the slightest rumor of graft or inefficiency. In fact, the only serious complaint that has arisen was in the one department operated by private contract, the commissary department.

COMPLETED TUNNELS THAT FORM PART OF THE GREAT AQUEDUCT SYSTEM.

That a municipality can do its own work more economically than contractors, is demonstrated by figures which show that bids received were higher than it has cost the city for doing the work; in some cases even twice as high. The single item, that the conduit across the Mojave Desert is finished with a cover, without going above the estimate for an uncovered trench, emphasizes the point I wish to make.

In this case, economy is not another word for stinginess, the work is thorough-going in every detail and the men are treated well. The law forbids the employment of the cheapest grade of labor on the coast, the Japanese, and the Chinese coolies, and the day's work is limited to eight hours. In addition to the care exercised for the men's comfort and health, and the fair rate of wages which prevails, there is an excellent bonus system which has produced world-record-breaking results in tunnel-boring.

In talking over the aqueduct project with Mr. J. B. Lippincott, Assistant Chief Engineer, I asked him what he regarded as the most interesting feature of the undertaking, and his reply was, "the bonus system," which is being operated with such success. All work, above a certain day's stint, which is done within the eight hours, is paid for, each man on the shift receiving a substantial addition to his wage. Mr. Lippincott remarked that with this incentive to work, the men did not need a shift-boss to urge them to do their utmost. The drones are weeded out by the laborers. It seems like such a reasonable proposition, on the face of it, for an employer to pay for what he gets, over and above the average day's work, that the only wonder is that it has not been adopted everywhere. On a big construction work, where the element of time enters so largely into the contractor's profit, it would be a matter of economy to adopt this system, and not only avoid labor troubles but also increase efficiency of his men.

In conjunction with the work on the aqueduct, the Whitney siphon being built at Newhall, California, is one of the most interesting pieces of concrete construction in the world. It is a gigantic

LINING THE CONDUIT WITH CEMENT.

pipe, nine hundred feet long and ten feet inside diameter, which drops sixty-five feet into a little valley and rises to practically the same height on the hillside opposite. When completed it will have a capacity of 430 cubic feet per second.

The siphon joins a tunnel at each end, and, as the great pipe is cylindrical, there is a gradual change in the shape of the forms from the arched roof and level floor of the tunnel to the cylinder. This siphon is said to be the largest concrete pipe in the world, the next largest having been built as part of the United States Reclamation Service project at Belle Fourche, South Dakota.

In addition to supplying the city with water, and irrigating vast tracts of arid land, there is one other advantageous feature of the Los Angeles aqueduct project, which would require a separate article to discuss in any detail, that is, the energy developed by the stream of falling water at the various power drops. It is estimated at something like 50,000 horse-power, steady flow day and night, with provisions for increasing to 120,000 horse-power, peak load, as required. This is enough to do the work of the city, running the cars and lighting the streets, with power to spare. What that means to Los Angeles as a manufacturing center can be imagined. To bring 50,000 horse-power or more into a metropolis, which has a good harbor, excellent railroad facilities and the southwestern part of the United States and Mexico as a market near at hand, that item alone would justify the expenditure of the approximately twenty-five million dollars,—and this is just a side issue of the Los Angeles Aqueduct.

A JAPANESE FANCIER'S COLLECTION OF DWARFS.

DWARF TREES AS DECORATIONS

By

RENÉ BACHE

THE culture of dwarf trees bids fair to become a fad in this country, our multi-millionaires having taken quite a fancy to them. In Japan, as everybody knows, they have been long familiar—the method adopted for their production being a sort of systematic starvation. The seeds are started in gourds, and the resulting plants, all through their lives, are supplied with a minimum of poor soil, and crowded in every possible way.

By such means the noble, sky-searching pine is reduced to a mere pigmy a foot or so in height, likewise the lofty oak, which becomes a ridiculous miniature of its proper self. The same processes are applied to various other species, including the "monkey puzzle" tree, which, though centuries old, grow in rows of little pots for the admiration and amusement of amateurs.

The dwarfing of trees for practical horticultural purposes, of course, is familiar enough. Mr. Luther Burbank, commonly known as the "plant wizard," has recently produced a pigmy chestnut tree, by crossing a Japanese with an American variety, which yielded fruit six months from the seed. Its burrs, and the nuts contained in them, are as large as those borne by an ordinary sized chestnut.

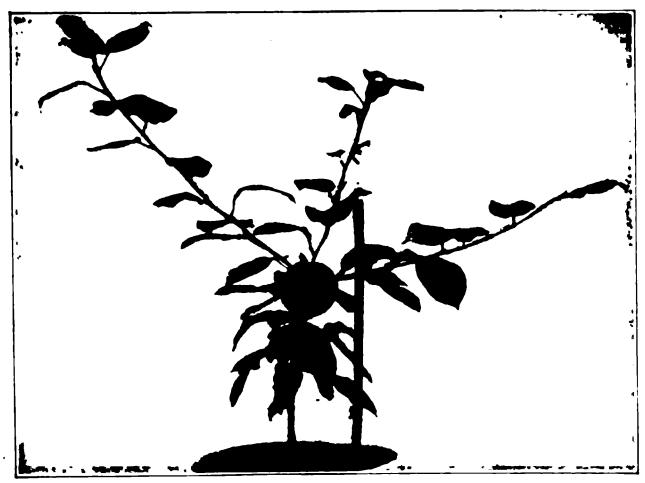
Apple trees are dwarfed for the orchard usually by grafting desirable varieties either upon the quince or upon a small wild apple known as the "Paradise

DWARF PEAR TREES OF THE NORTHWEST.
Compare with the hat.

LUTHER BURBANK'S LATEST WONDER.
Dwarf chestnut six months from seed, in bearing.

stock." Such trees, kept carefully pruned to reduce their size, are sometimes not more than five or six feet high, and yet bear large fruit. The same thing is done with the pear, by grafting it on the quince.

By similar means cherry trees are made dwarfs, and are used on dinner tables nowadays for decorative purposes —with trunks not more than an inch and a half in diameter, though four or five years old. The little trees are never permitted to grow more than three feet high. At the proper season they are set in pots, and placed in the hothouse for the purpose of forcing them into fruit. Finally, when the fruit appears, most of the cherries are removed while immature with a pair of scissors, only one hundred or so being allowed to ripen. As a result, they are far superior in size and quality to the best of ordinary cherries.



A DWARF APPLE TREE OF THE NORTHWEST.

The agricultural experiment station at Brookings, South Dakota, is at present trying to create for the prairie region of the Northwest hardy dwarf varieties of apples and pears—trees of absurdly small sizes, only four or five feet in height, but yielding the biggest kind of fruit. They are expected to add very importantly to the agricultural wealth of that part of the country.

CLIMBING MOUNT HOOD

Wonderful Trip Over the Glacier to the Summit of the Oregon Giant - 12,000 feet above the sea

THE START.

ON THE GLACIER.

ROPED TOGETHER.

CUTTING STEPS.

PHOTOS COPYRIGHT, 1908, H. C. WHITE CO.

A WIDE CREVASSE.

SIGNALING FROM THE SUMMIT.

A HUGE SNOW BANK.

ON THE EDGE OF A CREVASSE.

A HILL OF ICE.

AN ICE CAVERN.

PHOTOS COPYRIGHT, 1900, H. C. WHITE CO.

AMONG THE PEAKS.

ON THE SUMMIT.

ICE ARCHITECTURE.

ON THE WAY BACK.

A SNOW CREVASSE.

HOME AGAIN.

PHOTOS COPYRIGHT, 1898, H. C. WHITE CO.

THOSE ARKANSAS DIAMONDS

By

HARRY F. KOHR

FOR the first time in the geologic history of North America, diamonds have been found in the original matrix—in Arkansas. Three companies already are operating in the field and more than seven hundred diamonds have been found, the largest of them weighing six and one-half carats. While of course many of the stones are small and almost worthless, that is a characteristic of every diamond field. The larger stones, however, are of excellent quality and may be cut into finished gems with no more than the average loss in weight. They range in color from the purest blue-white to canary yellow and brown. Of the stones discovered, one is an absolutely flawless blue white gem weighing four and nine-thirty-seconds carats. Another is an absolutely flawless canary yellow gem weighing one and one-half carats, so perfect in shape as to require almost no cutting to make it a marketable gem. One diamond still retained in the matrix in which it was formed is estimated to weigh between three and four carats and apparently is flawless.

As yet, only the surface of the diamond field has been touched, and whether untold riches lie beneath it only time can tell. For the present the indi-

IN THE DIAMOND COUNTRY.
One of these men has just found a diamond.

cations all favor the belief that the mine will become an important factor in the diamond supply of the United States.

That the Arkansas diamonds are not the accidental relics of a bygone glacial age and that the field is both large and potentially immensely profitable has been thoroughly established. The most widely known diamond experts in the United States have pronounced the Arkansas gems fully the equal of the South African product and equally eminent geologists have defined the area in which they are found and pronounced it a true diamond crater, similar to the great diamond mines in South Africa, the peridotite formation in each being essentially similar.

As with every other great mineral strike, the Arkansas diamond field was discovered by accident. It was known as early as 1842 that there was a deposit of peridotite in Pike County and in 1890, John C. Branner, the State Geologist, mapped out the area. Still, while everybody knew that diamonds usually are found with peridotite, or in it, nobody ever seemed to associate the Arkansas peridotite field and the possibility of diamonds being found there.

Then along came John Wesley Huddleston in search of health and incidentally a gold mine. A rough patch of rocks and timber that sloped gently down to the banks of the Little Missouri River in Pike County, a few miles from the village of Murfreesboro, struck his fancy and he bought it for considerably less than the cost of the motor car that he rides around in now. He was a thorough believer in the amateur prospector's axiom that "Gold is where you find it," and the Arkansas hills looked as good to him as any other.

So Huddleston built himself a log cabin and, between hunting and fishing and tending a little garden patch, he roamed the country leaving the print of his prospector's hammer here and there and filling his pockets with "specimens." Arkansas is as full of crystals as it is of "razorback hawgs"and there were some of them on Huddleston's place. In his wanderings he picked up a few of them to add to the mineral collection in his cabin. One day in August, 1906, he picked up a small crystal that seemed different from the others he had found. It held and reflected the light better than others he had noticed. Still he knew that the

whole Ozark region abounded in crystals from which the widely known Hot Springs "diamonds" are cut and the latest specimen merely roused his curiosity for a moment and was then thrown into a cabinet with the others. There it caught the eye of his wife and it was she who suggested that it might be a real diamond. It was tried on a piece of glass and right there Huddleston made a discovery that threw himself and his wife and the rest of Arkansas into a fever of excitement. That particular crystal and one other in the cabinet cut glass, while all the others merely rubbed smoothly over it.

PICKING OUT DIAMONDS.

Huddleston's wildest flights of fancy had never contemplated a diamond mine. He had dreamed of gold, but diamonds! It was too good to be true. He hustled the saddle upon his old mule faster than it had ever been done before and went speeding off towards Murfreesboro with the two stones wrapped safely in a box in his pocket. Then he began to have doubts. Probably they were just some crystals a little harder than the others. His excitement began to subside. Just then he caught the glint of another crystal at the side of the road and dismounted to pick it up. It much resembled the others, and, with new hope, Huddleston hurried on to Murfreesboro.

The first man Huddleston went to see in Murfreesboro was the cashier of the little bank. The cashier wasn't a diamond expert but he was willing to take a sporting chance on Huddleston's find and offered fifty cents for the three stones. Huddleston believed that at that rate he, too, could afford to take a sporting chance and he kept them. Judge Pinnix, to whom Huddleston next showed the stones, tried them on a watch crystal and then suggested that they be sent to Charles S. Stifft, a jeweler in Little Rock, for an expert opinion. Mr. Stifft saw at a glance that the stones were diamonds and like a practical man he at once formed a syndicate to buy Huddleston's land. To make absolutely certain, Mr. Stifft, who had some little knowledge of the geology of diamonds, first examined the Huddleston land, and then had the stones examined by other expert jewelers. Their verdict agreed with his, so Mr. Stifft took the three to Dr. George F. Kunz, Vice-President of Tiffany's and probably the greatest authority in the United States on precious stones.

Dr. Kunz pronounced the stones diamonds all right but he also showed his visitor a map locating twenty-nine other places where diamonds had been found in the United States, sometimes one stone, sometimes several, each time proving to be merely a glacial deposit. He was not, therefore, deeply impressed, he said, with the finding of three diamonds unless further investigation showed that others were to be found in the same place and in the matrix. Until stones were found in the matrix, in the diamondiferous "blue ground" deposited by volcanic action, he said, it never could be told that a real mine existed. The wisdom of Dr. Kunz's experience, however, was that it never can be told where things, and especially diamonds, will turn up. He took enough interest in the find to suggest that Dr. Henry S. Washington, an eminent geologist of New York, be employed to pass expert opinion

on the geology of the field. Dr. Washington already was familiar with the location, having visited Magnet Cove near there in 1900 and written two pamphlets on the remarkable paleozoic strata there.

Dr. Washington visited the Huddleston place, and in the meantime eighteen other diamonds had been picked up on the surface, making twenty-one in all. After an investigation lasting several weeks, he gave his expert opinion that the diamonds had come from a real crater. A personal visit by Dr. Kunz followed and whatever doubts he may have had were shattered by his own investigation. With every opinion favorable, Mr. Stifft and his associates began to take up the options they had obtained and to spend money in development work. More than 1,000 acres of land on either bank of the Little Missouri was bought in and a core drill was put to work to define the limits of the crater, or diamond "pipe." The drill showed the outcrop of the crater to cover fifty-six acres on their land, while there was eight acres of overflow on another tract since taken up by the Ozark Diamond Company. This made the total area of the crater sixty-four acres, the second largest known diamond crater in the world. The Kimberly mine in South Africa is the largest, covering an area of eighty acres. The other South African diamond mines range from four acres up. A few months ago another peridotite area was discovered two and one-half miles northeast of the Huddleston tract and has since been taken over by the American Diamond Company. No diamonds have been found there, nor has any crater been discovered as yet.

It was not until May of last year that active operations were attempted by the Stifft syndicate, which had incorporated as the Arkansas Diamond Company. A small washing and concentrating plant for test purposes was installed. The results from this were so satisfactory that the small plant was taken out and a larger one put in. This proved a disappointment. Whereas the small plant had recovered an average of seventy-one hundredths of a carat per "load" of sixteen cubic feet, a bonanza yield, the large machine recovered only twenty-one hundredths of a carat. Later several diamonds were found in the tailings of the large machine and it was discarded as losing too large a percentage. Still twenty-one hundredths of a carat is a good yield. The average from the South African bonanza mines ranges from thirteen-one-hundredths of a carat in the Wesselton to twenty-three-one-hundredths in the Premier and twenty-five-one-hundredths in the Kimberly. The stones from the South African mines run an average of $10 to $15 a carat in the rough and the same valuation has been placed by the experts on the Arkansas diamonds. The three stones found by Huddleston were valued at $28 a carat, and weighed a little over six carats. Three other stones weighing gross four and eight-tenths carats were cut at Tiffany's and yielded a net weight of two carats, valued respectively at $175, $75 and $60 a carat.

After considering the results of their tests and figures on diamond production in other fields the company concluded that the prospect was satisfactory and it is now equipping the mine at a cost of $125,000 with the machinery necessary to economical mining operations. John T. Fuller, who was for five years general manager of the Dutoitspan mine, the largest of the Kimberly group, is superintending the work. Whether the production will be large enough to have an important effect on the diamond market in the United States will be known within another year. For the present all the indications are that it will. Diamonds are still to be found on the surface as the ground is being cleared of boulders and stumps, but to determine with any degree of certainty what the average yield per load of sixteen cubic feet will continue to be can only be determined by washing fifty to one hundred thousand loads of the "blue ground." It is estimated that more than one-half the peridotite outcrop has weathered to a depth of twenty to sixty feet, and that more than one and one-half million cubic yards of diamondiferous blue ground can be taken out with the minimum of effort.

When this is washed and the diamonds sorted from it, the owners will be

able to judge approximately what the value of their mine is.

The Arkansas diamond field lies in Pike County and is about one hundred and twenty miles from Little Rock. The nearest town is Murfreesboro, a village of about two hundred people. A railroad has just been built through the country. Geologically, the diamond bearing area lies in the Caddo Group Quadrangle on the east bank of the Little Missouri River near the junction of Prairie Creek with that stream. It is in a rough and wooded country at an elevation of about four hundred feet above sea-level. The country is well watered and the climate is good. The diamond bearing "pipe" is really the crater of an old volcano filled up solid with peridotite, a rock of bluish green color known in Africa as Kimberlite and generally as "blue ground." The use of this latter name, however, is apt to be misleading, since persons unacquainted with the diamond mines are likely to take it for granted that "blue ground" means a soft clay which presents no difficulty or great expense in washing. The peridotite, however, varies considerably in hardness. In most cases it will disintegrate readily after a few months of exposure to the atmosphere, changing to a dull grayish or yellowish green color. It then can be easily pulverized and washed and the inclosed diamonds recovered. The harder variety, called hardibank, remains solid, however, and must be crushed in order that the diamonds may be recovered. How far down the deposit extends has never been determined in any mine. Usually the "pipe" is funnel-shaped for the first hundred feet and then maintains a uniform circumference. The deepest mine at Kimberly is over three thousand feet down with no diminution in the quantity of diamond-bearing rock.

GOOD-BY, TROLLEY CAR!

By

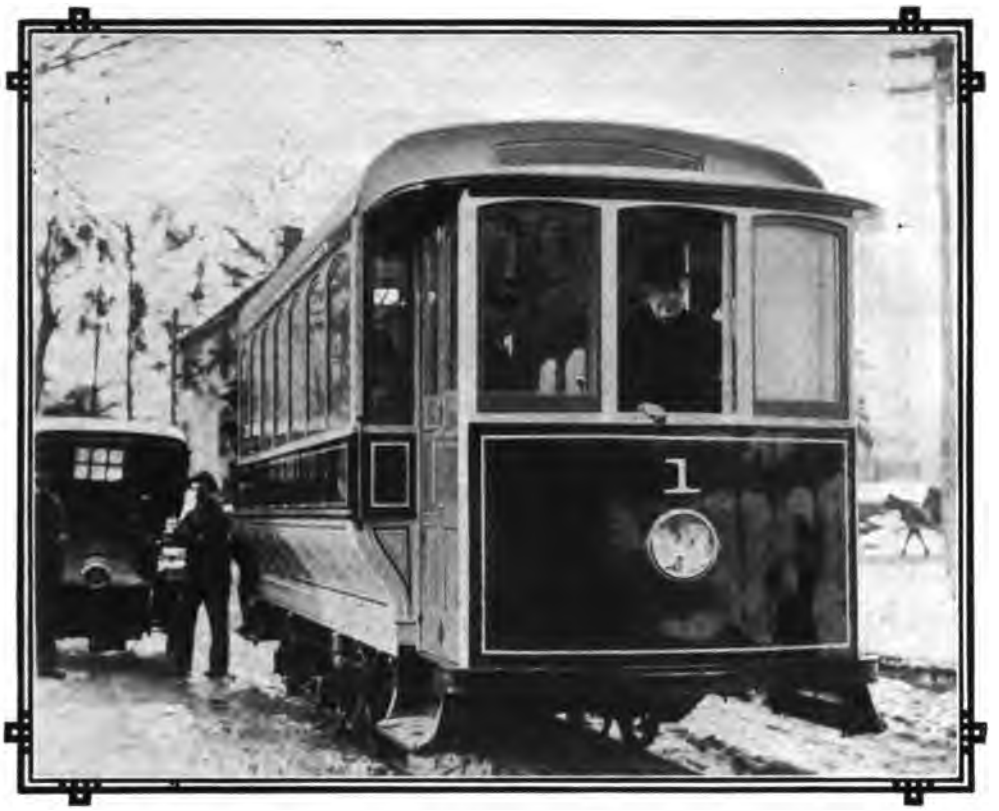
HENRY R. JEVONS

FOR two years Thomas A. Edison and R. H. Beach, Electrical Engineer, have been contriving, scheming and conspiring secretly behind high board fences in West Orange, New Jersey, to deprive several thousand hard working trolley cars of their jobs. Judging by present indications the conspiracy seems likely to be a success, thanks be!

For, with the trolley car will depart forever its outrageous cost of maintenance and operation. When that time comes we shall have the pleasure of knowing that the stockholders in street railways are drawing extra dividends. Perhaps they may even let us have the core in the shape of three cent fares—but no; we must not expect too much. Anyway, when the trolley car is gone we can take down the clutter of wires overhead, thus making it possible for the band wagon to drive down Main Street without danger of bisecting the bass drummer in his golden perch away above the rest of the musicians, so we can have circus parades once more, and that will be a great deal.

All these possibilities are crystallizing because Edison, years ago, got the notion that he could make a better storage battery than any one else ever did. The sequence of events which grew out of that notion has finally led up to a storage battery street car that will really run and carry passengers. Yes, and it can get back to the barns the same day, too, which is more than some storage battery cars have been able to do.

Really, it did not seem difficult to improve upon the original lead storage battery, for it was remarkable chiefly for



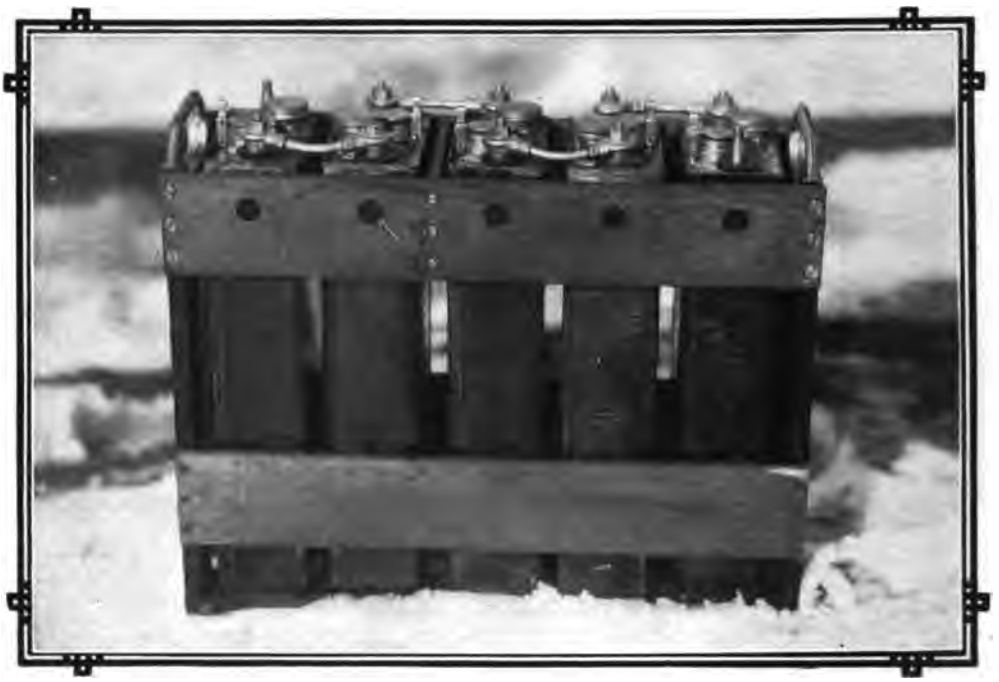
EDISON RUNNING THE FIRST CAR WITH HIS LONG AWAITED STORAGE BATTERIES.
These batteries are expected to revolutionize every form of self-propelled vehicle and craft.

what it could not do. It was bulky, it was heavy, it was weak, it was as capricious as a girl with two beaux, it was dirty, and the odor of it, while being charged, would shame a soap factory. Moreover, the sulphuric acid fumes ate up iron and steel so that just when you particularly wanted your vehicle or other apparatus supposed to be run by the battery to stand up to its work that was the psychological moment it chose to have heart failure or something. And the charging of one of the things was a more critical operation than feeding a sick baby. If you overcharged the battery it went to pieces; if you didn't feed it enough current it was demoralized.

Edison's storage battery was duly launched more than six years ago. Measured by the old lead battery it was a brilliant success. It was lighter and cheaper and cleaner and yielded a greater output of power for a given weight than the lead battery, did not deteriorate when left uncharged and was not injured by overcharging. More than two hundred and fifty delivery wagons are being operated today in New York City by the original Edison battery. Some of them have been in use from two to five years, giving a more economic service than horses with very little trouble due to batteries. The average cost has been $36.50 per battery per year.

It was decidedly the best storage battery ever produced, but it was not good enough to realize the wonderful possibilities Edison saw in the transportation field. He had not hit the right combination, after all. Although his original battery was a commercial success Edison withdrew it from the market, to the boundless grief of his business managers, shut up the factory, turned out the workmen and resumed his experiments.

Considering that there is never but one right way to do a given thing it is truly wonderful how many wrong ways there are of doing the same thing. By industry and perseverance Edison found out nine thousand different ways not to build a storage battery. But the more Thomas A. Edison can't do a thing the more determined he is to do it. Having eliminated every possible wrong way, experiment number nine thousand and one revealed the right way to build the ideal storage battery.



A SET OF FIVE BATTERIES AS USED IN THE EDISON STORAGE BATTERY CAR.

After it had withstood every kind of shop test successfully the improved battery was given a trial on a Lansden wagon under actual service conditions by one of New York's big department stores. The larger size battery known as "Type A-6," weighing 1,200 pounds was put on a wagon weighing 2,460 pounds, making the weight of wagon and battery 3,660 pounds. On its first trip, in May, 1909, this wagon was run three consecutive days without recharging, covering in that time a distance of ninety-three miles over hilly roads in New Jersey and Staten Island.

Next, the "Greyhound," as the wagon was christened, was put on the Coney Island route, the longest and hardest route covered by any store in New York. It is from sixty-three to sixty-seven miles long and requires from a hundred and fifty to three hundred stops for deliveries. The "Greyhound" covered the route in eleven hours, averaging eleven miles an hour for the actual running time. On another test the "Greyhound" covered ninety miles in a day, making about a hundred stops. The charging plug was taken out at eight o'clock in the morning and was not put in again until 3:30 o'clock the next morning.

For three weeks the "Greyhound" was given the meanest service the chief engineer and garage superintendent could think up. It averaged fifty-seven miles a day for the period and regularly returned good for ten or eleven miles more. Then they had to admit that the "Greyhound" was capable of serving the longest and hardest delivery route operated in New York City and that no driver, even with a boy to assist in delivering the goods, could drive the wagon as far

in a day as the battery was capable of going.

This satisfied Edison, so the storage battery factory was re-opened and the men recalled. Then, while the factory was busy building batteries for wagons and carriages, which went off like the proverbial hot cakes, he sent for R. H. Beach, electrical engineer and expert on street cars.

"Do you know anything about street cars?" asked Edison.

"Do I? Why, I could build a street car with one hand tied."

"My dear Mr. Beach, the whole trouble with the trolley car," said the inventor, or words to that effect, "is that it is built by men who know all there is to know about it. The result is the same as it has been in the history of all great undertakings since Pharaoh, or whoever it was, built the pyramids: either they do not progress, or they progress backwards.

"The street railway is in the same predicament as the steam railroad: more power is wasted in hauling superfluous dead load than is needed for transporting paying live load. If this craze for building ponderous steel cars is carried much farther we may expect to see the time when the heaviest locomotives the rails will support will only be able to haul trains on the level, and passengers will have to get out and walk up hill as they did in the good old days of the stage coach. The new storage battery, if enough cells are put in, will run the regulation trolley car; but what's the use? It would be done at a criminal waste of money, though the battery would not be to blame for that but only the needless dead weight of the car, and though the waste would be no greater than with the present methods of generating and using power.

"What we want to do is to get the proportion of dead load to live load down to an irreducible minimum. If we can do that the new battery will get all the glory and it will be in a position to stand on its own merits before anybody stops to figure out that we haven't wrought a miracle, after all, but have merely exercised a little horse sense.

"So I should like to have you approach this car problem with a vacant mind—er, well, not exactly that, but without any undue reverence for standard practice. Never mind about how cars are built now. Begin at the first verse of the first chapter of Genesis and find out how a car should be built."

With this understanding, space was set aside for an experimental track, expert workmen were detailed to work under Mr. Beach's orders and early in 1908 the quest for the ideal street car was begun. Wheels being the foundation of a car, so to speak, experimenting began with them. An ordinary street car wheel is of cast iron, weighs about six hundred pounds, and costs about three cents a pound. Beach and his corps of Missourians broke them in testing machines until they knew all about the weaknesses of cast iron wheels. Then they made wheels of other materials and tested them until they found something that could not be improved upon. The ideal wheel was of manganese steel; and while it only weighed one hundred and twenty-five pounds, or less than a fourth of the weight of a cast iron wheel, it was actually stronger. And while a manganese steel wheel cost $23.75 as compared with $18 for a cast iron wheel the steel wheels were the cheaper investment, for the expense of rolling the weight of the superfluous nineteen hundred pounds of cast iron in four wheels around the street under a car would quickly compensate for the extra first cost of the better wheels.

Having settled the wheel question the next thing to do was to get axles to put them on. Any street car builder who knows his business will tell you that you cannot possibly get along with anything less than a four-inch axle for a four-wheeled car. By the same laborious process of experimenting that led to the discovery of the light wheel, an axle only two and a half inches in diameter was produced that afforded the same factor of safety as the clumsy four-inch.

As the roof did not have to support a trolley pole but was only needed as a protection from the weather, the thing to do was to find the lightest possible material that would have the requisite stiffness and strength. A wearisome lot of failures was scored before a molded roof that met all the requirements with-

out adding an unnecessary pound to the weight of the car was produced. When it came to windows Beach went to New York to make the purchase in person.

"What have you that is suitable for car windows?" he asked of the dealer.

"American plate glass; that is what they all use. Of course it isn't really plate glass, but it's nice and thick and heavy."

"Won't do at all. Have you nothing better?"

"M-m-well, of course, if you are willing to pay a little more I could give you French picture glass. It is clearer, much higher grade and is just as strong as the American plate glass but is only half as thick and heavy."

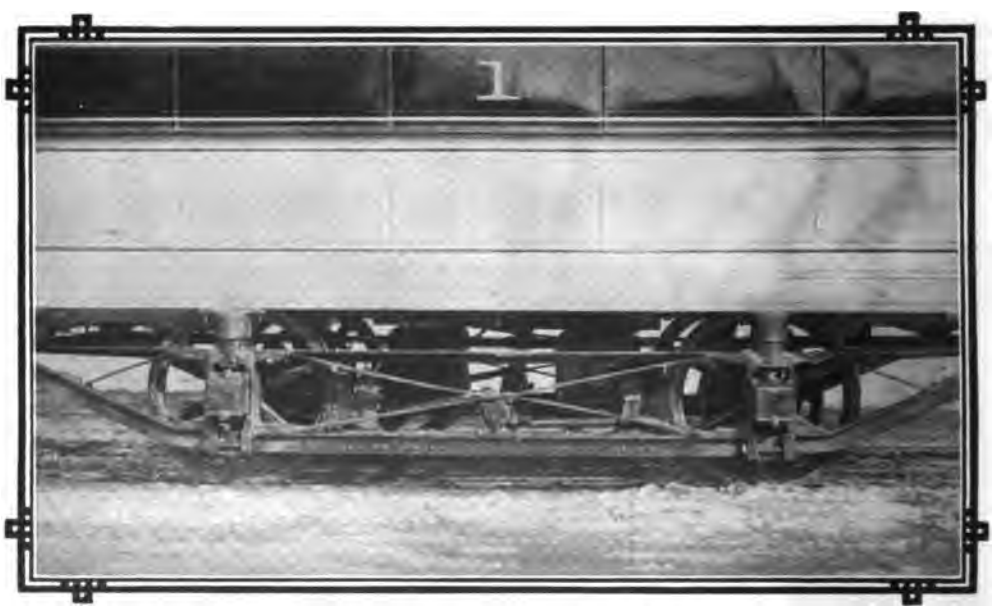
"Now you're talking. The greatest strength with the least weight is what I am looking for."

Every detail was worked out in the same painstaking way until the first car was completed. It did not carry an unnecessary pound of material anywhere. In fact, it wasn't strong enough. That much was foreseen; the point was to find out exactly how much was lacking. That car was taken out on the experimental track behind the high board fence where Beach and his corps harried and abused it as if it had been a wild bull and they Spanish bull fighters until it went to pieces. Another car, lighter, stronger and more practical was built and again Beach and his matadors tortured the poor thing into wrack and ruin.

Profiting by what failures had revealed, a third car was built and turned loose on that experimental track. Except that it was lighter and more graceful it looked just like an ordinary trolley car seating twenty-six passengers. It was operated by the same mechanism, managed by the same controller, but the car itself weighed but seven thousand pounds and the storage battery three thousand pounds more, making a total weight of ten thousand pounds as compared with an average weight for a trolley car of the same capacity of twenty thousand pounds.

Beach's matadors did their worst to Car No. 3. They chased it up and down and around the track at slow speed, high speed and half speed, with full load and no load at all. They tried everything their ingenuity could suggest; but when the experimenters had reached the end of their resources and Edison's bank account was smaller by seventy-five thousand dollars that last car wasn't feazed.

Then Beach went to the telephone and called up an old friend, a street railway



THE SIMPLICITY OF THE MOTIVE FORCE OF EDISON'S CAR.
The trucks are light and the car is chain-driven.

SETTING THE BATTERIES IN THE NEW CAR.

manager who had been vastly amused by the idea of any one trying seriously to improve upon the twentieth century trolley car. Upon being invited to attend the first appearance of the new storage battery car upon any public track the street railway manager chortled out a derisive acceptance and added:

"And I'll bring the wrecking car with me to pick up the pieces for you."

Some one to whom a primrose on the river's brim is just a yellow posey and nothing more must have overheard that conversation over the wire for the news was spread broadcast that Edison's new storage battery car was to appear in the streets of Orange on a certain day accompanied by a wrecking car to pick up the pieces. When the time came for the gate in the high board fence to open the audience included besides the invited guests thirty-one reporters by actual count and all the small boys—and there are a good many of them—in Orange, East Orange, South Orange, West Orange, North Orange, Middle Orange, and all the rest of the Oranges.

Storage battery cars not being provided with steering gear a team was hitched to one end for guiding purposes, the current was turned on and the car under its own power went bumping over the pavement to the street railway tracks. The instant it was on the rails the guests, invited and otherwise, climbed aboard until the car was packed worse than a New York subway train in the rush hour. At first Mr. Beach was inclined to be peevish over this unsolicited acceptance of his hospitality, but thought better of it when he reflected that if the new car stood up under such a test it would have nothing to fear from any possible condition of service.

That car was trundled around the tracks of the Oranges, including some of the stiffest grades in that locality for a distance of thirty miles. By that time everybody, including Edison who had managed to squeeze himself aboard, was

satisfied. Even the street railway manager who had come to scoff remained to sing the praises of the storage battery car.

Next day orders were given to build an addition to the storage battery factory that would double its capacity. At the same time another large factory was set aside for car building, for the light construction system has been patented. The new cars are to be built on the automobile plan; that is, the various parts are to be manufactured in outside establishments that specialize in certain lines and the finished parts are to be assembled at the Edison plant in West Orange.

The storage battery car is capable of running one hundred and fifty miles without recharging at a cost of one cent a mile, and of climbing any ordinary grade. It saves twenty-five per cent on the cost of line construction, for there are no overhead wires, no poles, no transmission cables and no track bonding. There is also a material saving in the cost of power plant, too; for on a trolley line the power plant must be large enough to move the maximum amount of traffic, which continues for only a short time; the rest of the day there is a large surplus of power that is not used. The power station for charging storage batteries can be run at its most economic gait every hour in the twenty-four.

The greatest saving is in the cost of operation. The Edison patent storage battery car weighs only from one-half to two-thirds as much as the ordinary trolley car of the same capacity, yet the Edison car is the stronger. As it costs one hundred dollars per ton per year to run the average street car on the average street railroad it may be seen that this saving is of some consequence. Thus, if a trolley car weighing ten tons is required to haul a certain number of passengers a given distance and a storage battery car weighing seven tons can render the same service there would be a saving of $300 a car a year on dead weight alone, and on a hundred cars $30,000.

There is a loss of 25 per cent in power from the time the current leaves the generator in the power house until it has been used in the motor of the car. But this is no greater than the average line loss in a trolley system.

The new car will be particularly adapted for service where traffic is light, since it brings the cost of construction and maintenance down to a minimum. It is equally well adapted for heavy traffic where overhead wires are not permitted and also where underground trolleys for any reason are impracticable. West Street, in New York, is precisely such a line. Street traffic being exceedingly heavy, overhead wires are out of the question. Underground trolleys are equally impracticable owing to the danger of flooding the conduits at high tide. So the horse car has things its own way in West Street. Think of horse cars in the heart of the metropolis of the Western hemisphere in the year of grace, 1910!

The battery which has made the new type of street car possible is made up of cells built in two sizes. The larger size, suitable for cars, consists of a nickel plated corrugated steel retaining can 3¾ inches thick, five inches wide and 13⅜ inches high containing the electrodes and the electrolyte, as the fluid in which the electrodes are immersed is called. The larger cell complete weighs 19.2 pounds, the smaller 13.5 pounds. The positive electrode consists of six plates each of which is made up of thirty tubes four inches long and about the diameter of a lead pencil. The tube is made of perforated steel filled with oxide of nickel mixed with flakes of pure nickel to increase the conductivity of the mass. The negative electrodes are plates consisting of gridirons each of which contains twenty-four flat rectangular pockets made of perforated steel and filled with iron oxide. Positive and negative plates are assembled alternately in the cell on rods connected with their respective poles, properly spaced by nickel washers and held in place by nuts. The outside plates are insulated from the can by sheets of hard rubber. The electrolyte is a twenty-one per cent solution of potassium hydrate with a small amount of lithium hydrate in distilled water. Each cell has a cover welded on containing four openings for the poles, for filling and for the escape of gas while charging.

For convenience in handling the cells are assembled in trays.

Ordinarily a battery is charged for seven hours; but the first time it is charged for fifteen hours. This overcharge is repeated once every two weeks for the first two months and every two months thereafter. If the overcharging is properly done and the cells are kept filled with distilled water the battery increases in capacity for one to three months and will then last longer than if not properly treated. The only additional care required is to keep the trays clean and renew the potash solution every eight months. Each cell holds four pounds of the solution, which costs eight cents a pound.

NEW VEGETABLES FOR THE SOUTH

By

ROBERT FRANKLIN

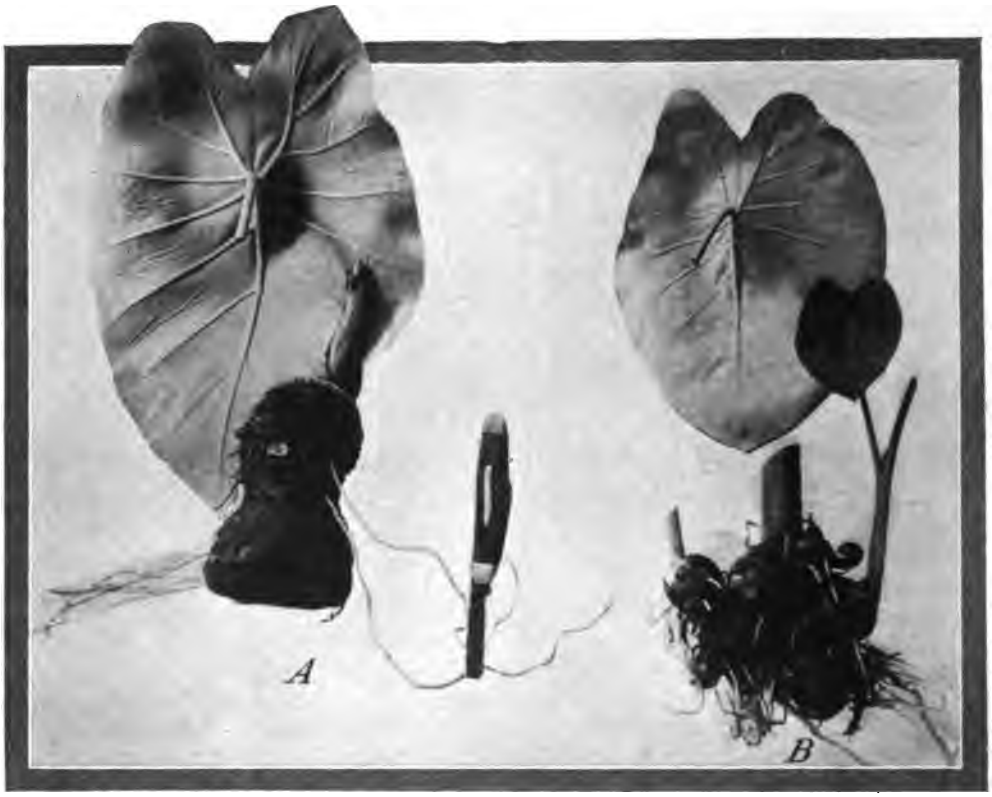
TO meet the need of the wet soils of the South Atlantic and Gulf states, which, by reason of their excessive moisture, are unsuitable for ordinary crops, the government plant bureau is going to make an effort to introduce in that part of the country certain new vegetables—namely, the "yautia," the "taro," and the "dasheen," which promise to be exceedingly valuable, inasmuch as for centuries they have formed the staple food of the Hawaiians and the inhabitants of Polynesia generally. In fact, they are largely cultivated in China, Japan, and the Malay Archipelago. But they are strange to us.

These plants have large tuberous roots, rich in starch. They yield heavily — from two to four times the average yield of potatoes. One variety of yautia, which has been secured for propagation, produces fifteen tons of edible tubers to the acre, and, in addition, five tons of rootstocks suitable for stock-food or the manufacture of starch.

The yautia, the taro and the dasheen all belong to the same family. In appearance they resemble the "caladium," or elephant-ear plant, which has become familiar within recent years as an ornamental in American gardens. Stemless, their great leaves rise direct from the rootstock or its tubers, sometimes attaining a length of eight feet. The dasheen might be called a tuberous-rooted taro, usually dwarf in size, and has shield-shaped leaves. Leaves of the yautia are arrow-shaped.

FLOWERS OF THE YAUTIA—A VALUABLE TROPICAL PLANT.

It seems rather odd that these vegetables should



be new to us, inasmuch as they are among the oldest cultivated plants in the world. As for the taro, its culture seems to have first begun in Polynesia, where it was regarded anciently as sacred, being dedicated to a goddess. Most of us have read of the "fatal taro patch," the ripening of which was celebrated by the sacrifice of human beings—the latter furnishing the pièce de resistance at the feast thereupon held.

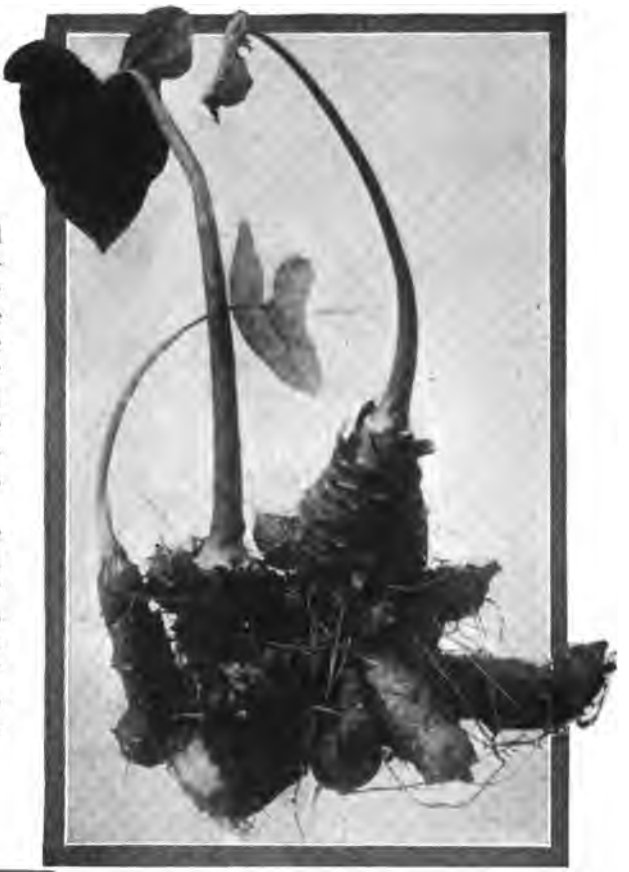
Of the taro there are a number of known varieties, the most widely distributed of them all being the "eddo" of the West Indies, which in Porto Rico is known as "malanga." In Hawaii grows the highly-colored "royal taro," which gets its name from the fact that in former days it was raised solely for royalty, in that archipelago. It is an upland variety, with rose-colored roots, containing a blood-like sap, and requires comparatively little water. The plant bureau is of the opinion that it should soon obtain rec-

A—The Yautia Tuber; B—the Taro; Cultivating the Latter.
Taro flour is an easily digested food.

ognition in our own country as a first-class table tuber for the fancy vegetable market.

Taro flour—made by grinding the cooked roots—has been on the market in the United States for several years, and is said to be a very easily digested food, suitable for invalids, infants, and persons afflicted with weak stomachs. The principal food of the native Hawaiian people, by the way, was a dish called "poi," made from the taro root, and in their language there was no such word as indigestion. The rootstocks are eaten boiled or baked, and are frequently used for thickening soups and stews.

The young leaves of both the taro and the yautia are expected to prove valuable additions to our list of potherbs. The boiled leaves are served with a milk or cream sauce, or fried like cabbage, or made into croquettes, with eggs, cheese and milk. H. F. Schultz, who has charge of the vegetable gardens of the Canal Zone, on the Isthmus of Panama, has grown thousands of pounds of "yautia spinach," within the last two or three years, for the American officers working on the canal, and it has earned high approval, being tender, spicy, and palatable. Indeed, it has been found difficult to raise enough of it to supply the demand.



A Superior Variety of Yautia.

Dasheen—Rootstock and Tuber.
Of the same family as the yautia and the taro.

In tropical countries, generally speaking there is a chronic famine of vegetables. Not only on the Isthmus of Panama, but in many other regions where railroad building or other work is being done by men from Europe or the United States, the lack of fresh garden truck is a difficulty that seriously interferes with comfort and health. Our vegetables refuse to grow in those latitudes. Accordingly, it seems important

that use should be made of vegetables native to the tropics, such as yautias and taros.

Yautia flour is made by grinding dried slices of the peeled tubers. In the West Indies it is considered quite as palatable and more nutritious than the famous cassava meal, and, unlike the latter, contains no prussic acid. Made from the red or yellow variety, it should prove—in the opinion of the plant bureau—an attractive food article in Northern markets. Seventy per cent. of the peeled tuber is water; thus ten pounds of yautia tubers will yield, after three hours' drying, about three pounds of flour, which will keep indefinitely without becoming musty, if protected from moisture.

Yautia tubers, boiled, form a large part of the diet of the laboring classes in tropical America. Sliced and fried, they enter into many dishes on the planters' tables. The larger tubers are baked and served like baked potatoes.

The yautia, the taro and the dasheen are all three harvested in much the same way—namely, by pulling them up by the roots. A firm grasp upon a bunch of the leafstalks will usually bring up the entire root system. If some of the tubers break off from the rootstock, a blow or two with a hoe will fetch them to the surface. In the West Indies a method commonly adopted is to dig about the rootstock, and remove the ripe tubers with a knife or the fingers. This permits the plant to continue growing, and as much as thirty tons of tubers may be harvested from a single acre thus treated, in the course of eighteen months or so.

AN APOSTLE OF HUNGER

By

DR. ALFRED GRADENWITZ

AFTER all the recent simplifying of the diet of man, there has only remained one step towards reducing it to nought, toward replacing alimentation by fasting. Now this doctrine has found an ardent advocate in the person of Miss Clare De Serval, who has achieved fame by "fasting cures" far exceeding the performances of "hunger artists," like Succi, Cetti and Breithaupt. Unlike the latter, Miss De Serval also excludes any sensational element from her experiments, which are merely inspired by the love of science—the experimenter having been herself a student of medicine—and a desire to improve the status of human society.

The doctrine established by Miss De Serval is based on the following principles:

(1) We generally eat too much and too irregularly; our diet is far from being natural.

(2) Everybody, young and old, healthy and sick, should fast two days each week.

By following these main rules, man would, in Miss de Serval's opinion, succeed in entirely abolishing sickness. As regards existing maladies, these could be cured entirely by repeated "fasting cures" of more or less duration, provided that the last strength of the patient be not yet exhausted. As a matter of fact, the necessity of surgical operation has been avoided in many cases and illnesses have been cured, by applying a special diet and subsequent fasting cure.

In connection with her repeated fasting experiments, Miss de Serval merely desired to enable a medical investigation of the physiological effects of fasting to be made, while suggesting imitation by her examples. During these strange experiments, she is enclosed in a glass box about nine feet long, six feet wide and eight feet high, closed hermetically on all

sides except for the air windows which are covered by metal gauze so tight as to prevent the introduction of even the slightest trace of nourishment.

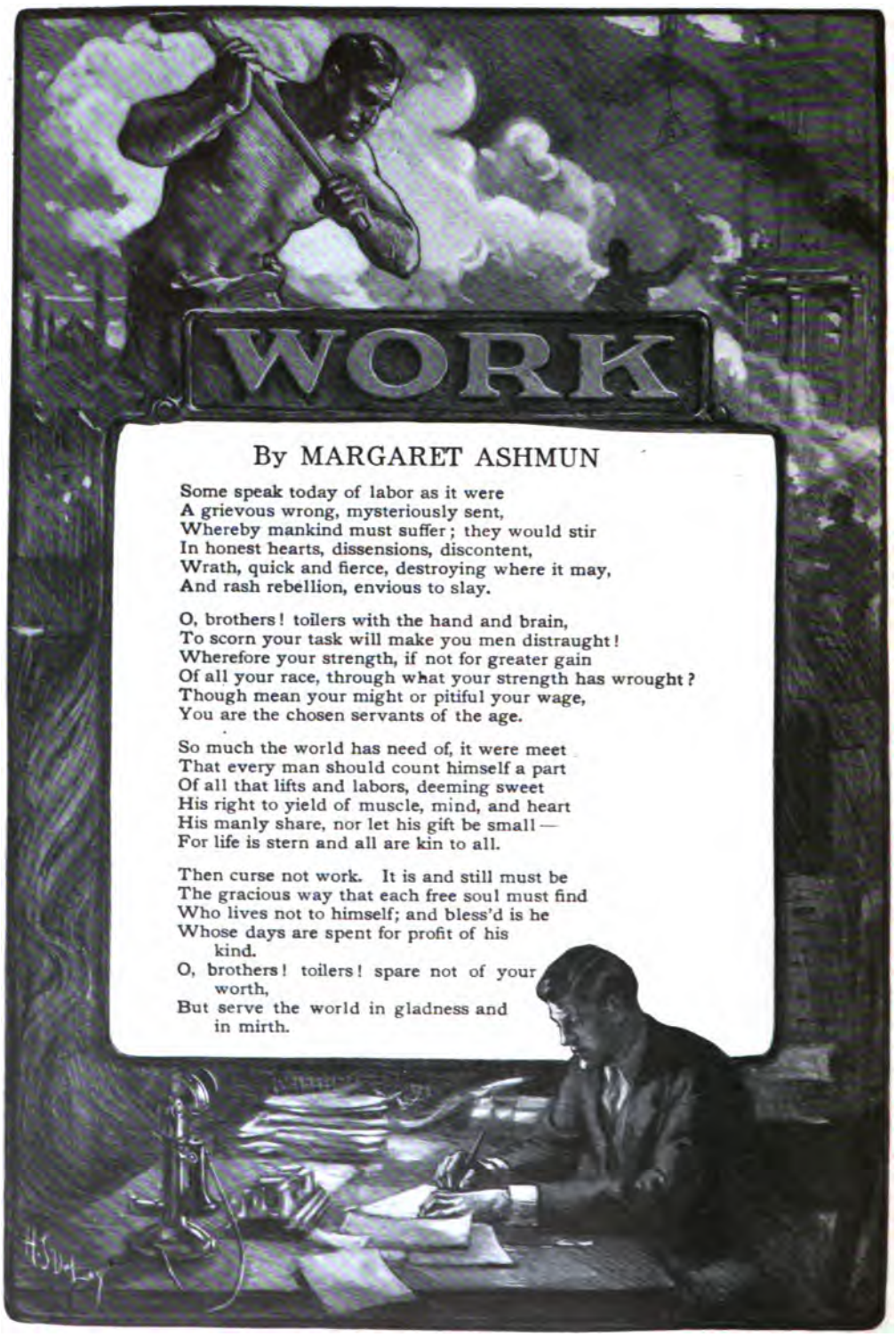
According to her extensive experience, Miss De Serval during her fasting experiments always feels perfectly well. In fact, fasting seems even to produce an increased well-being, so that the experimenter only reluctantly gives up fasting. During these fasting experiments her brain is always in a state of increased and more lucid activity; any uneasiness, trouble or sorrow is found to have vanished entirely, and the subject looks forward confidently even to a future far from being settled or pleasant. These effects thus are similar to those of the first stage of intoxication but for the absence of any reaction.

Miss De Serval recently ended a fasting cure lasting forty days. She has succeeded in the past in curing herself from serious neuralgia and nervous headache against which all attempts of medical men had been unsuccessful for years, merely by strict fasting cures of short duration—two to six days; she also hopes to improve, if not cure, an ear trouble, due to the taking of quinine for malaria.

Her experiments have shown even ten days' perfect fasting attended by heavy physical work to reduce in no way the strength of the body, and to exert a by no means detrimental influence on the health; in fact, she even feels better at such times.

How should, however, the well-known fact, that death often occurs after a far shorter fasting period, be accounted for, in view of the facts above stated? Miss De Serval obviously possesses special capacities, and, moreover, a rare strength of character. Furthermore, it should be considered that water, even in slight amounts, extraordinarily increases the force of resistance of the human body, though Miss De Serval has been able even to fast twelve days without drinking any water. In trying to solve this riddle, the psychological point of view, which is so frequently neglected for the sake of purely physiological phenomena, should obviously be taken into account. While personal energy greatly increases the force of resistance, depression of the mind obviously may be able to cut short vital phenomena which the body would otherwise still be able to keep up for a long time. The striking fact that, in the case of grave catastrophes, the victims are often found living after a considerable number of days, should therefore be ascribed to the invigorating influence of the hope of rescue and to the absence of any point of comparison enabling the duration of captivity to be adequately gauged that might lead to absolute dejection and despair.

CLARE DE SERVAL IN HER "FASTING BOX."



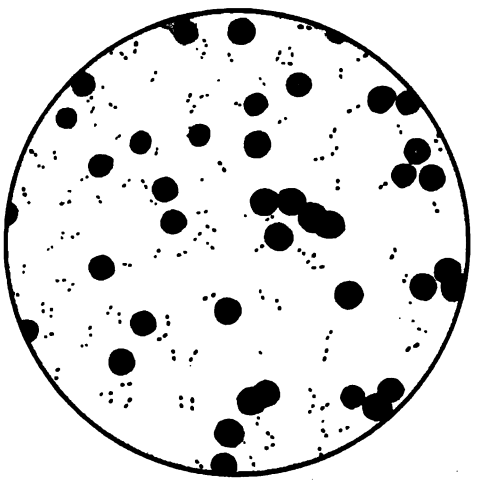
By MARGARET ASHMUN

Some speak today of labor as it were
A grievous wrong, mysteriously sent,
Whereby mankind must suffer; they would stir
In honest hearts, dissensions, discontent,
Wrath, quick and fierce, destroying where it may,
And rash rebellion, envious to slay.

O, brothers! toilers with the hand and brain,
To scorn your task will make you men distraught!
Wherefore your strength, if not for greater gain
Of all your race, through what your strength has wrought?
Though mean your might or pitiful your wage,
You are the chosen servants of the age.

So much the world has need of, it were meet
That every man should count himself a part
Of all that lifts and labors, deeming sweet
His right to yield of muscle, mind, and heart
His manly share, nor let his gift be small—
For life is stern and all are kin to all.

Then curse not work. It is and still must be
The gracious way that each free soul must find
Who lives not to himself; and bless'd is he
Whose days are spent for profit of his kind.
O, brothers! toilers! spare not of your worth,
But serve the world in gladness and in mirth.



DROP OF RABBIT'S BLOOD INFECTED WITH PNEUMONIA.

PNEUMONIA TO BE CONQUERED

By

CHESTER CARTON

IF further experience with pneumo-bacterin confirms the brilliant successes already achieved with the newest of bacterial vaccines the world may hope to see the King of Death shorn of most of his fatal powers, and perhaps even degraded to the lowly position of small-pox in the mortality tables. For the benefit of the "laity," as the doctors call those who supply their daily porterhouse, it may be explained that "The King of Death" is the title conferred upon pneumonia by that part of the medical fraternity which sometimes talks plain United States. Some, more-long-winded, have proposed "Captain of the Men of Death" as a fitting characterization of this terrible disease.

No matter what it is called, pneumonia continues to be,

what it has been for years, the cause of more deaths than any other one thing. Its ravages are not limited by any geographical bounds, for it is as deadly in the South as in the North, in the West as in the East. High altitudes and low are all the same to the King of Death, whose harvest continues the year around, though perhaps his busiest seasons are winter and spring.

For some unknown reason the death rate from pneumonia has been increasing appallingly for half a century. In 1860 the death rate from pneumonia in the United States was 44 per 100,000 population; ten years later it had jumped up to 102.4; in another decade it was 125.8; in 1890 it had increased to 188.4; in 1900 to 197.8. In the latter year pneumonia caused 10 per cent of all deaths, the most prominent three causes of death being, 1, pneumonia; 2, consumption; 3, heart disease.

Dr. Reynolds, former Health Commissioner of Chicago, has said that since 1900 pneumonia has caused more than one-eighth of all the deaths in that city. It has caused 33 per cent more deaths than consumption, and 44 per cent more deaths than all other contagious and infectious diseases combined, including diphtheria, influenza, measles, puerperal fever, scarlet fever, typhoid fever, erysipelas and whooping cough.

Investigation has shown that the death rate in New York and other cities for all the principal causes has decreased from 10 per cent to 35 per cent, except in four principal groups, in which there has been an increase. These are, 1, acute respiratory diseases, which increased 10 to 15 per cent, due principally to pneumonia; 2, cancer; 3, disease of the circulatory apparatus; 4, diseases of the kidneys. All this has taken place in the face of a steadily decreasing death rate for the country at large. In 1860 the death rate was 20.73; in 1908 it had been reduced to 15.4.

It is true that the mortality statistics for 1908 published by the U. S. Census Bureau covering a registration area which included 51.8 per cent of the total population, showed that pneumonia had again changed places with consumption, the death rate for the latter cause being 173.9 per 100,000 of population and 136 for pneumonia. This was a decrease from 161.2 in the preceding year, and was also much below the average for the five years preceding, which was 159.3 per 100,000 population. There is every reason to suppose, therefore, that the decreased death rate in 1908 was due to some freak of conditions, as yet unexplained. Certainly the doctors were not to blame, for about all they have been able to do in

cases of pneumonia has been to send a bill to the family after it was all over.

The utter helplessness of the doctor in cases of pneumonia has been acknowledged in print too many times to be controverted. As a matter of fact no progress whatever has been made in the treatment of the disease in the last one hundred years. Townsend and Coolidge—according to the accepted standard of professional ethics it is very bad form to publish a physician's initials, professional position, or principal place of practice—after making a statistical study of 1,000 cases of pneumonia treated at the Massachusetts General Hospital from 1822 to 1899 reached this conclusion: "Treatment has not, therefore, influenced the mortality rate. . . . Treatment has not influenced the duration of the disease nor its convalescence." Grim proof of the accuracy of these two physicians' assertions is found in the fact that one-fourth of the thousand cases under consideration died.

Sears and Larrabee in studying 949 cases of pneumonia at the same hospital from 1895 to 1900 found a death rate of 35.9 per cent, or considerably higher than in the earlier period. They were, therefore, constrained to agree with Townsend and Coolidge that pneumonia was not influenced by treatment. Ashton and Landis, after studying 991 cases of pneumonia at the Philadelphia General Hospital from May 1, 1897, to October 1, 1904, in which more than half the patients, who included many aged paupers, died, also agreed with the other investigators named, that "the course of these cases was uninfluenced by treatment."

These ghastly records should help even the "laity" to appreciate adequately the tremendous significance of the discovery of the first remedy that holds out even any hope in the treatment of a disease that claimed 61,259 lives from one-half the population in 1908; and that in the five years from 1904 to 1908 inclusive slew 297,508 victims in the registration area of the United States, which during the period averaged scarcely half the total population.

And pneumo-bacterin, it must be said, has done a great deal more than hold out hope in the cases in which it has been tried. Before going any farther it should be explained that the pneumo-bacterin treatment is first cousin both to vaccination for small-pox and antitoxin for diphtheria, but is not exactly like either. In a word, the doctor kills the bacteria of pneumonia and preserves them in a salt solution for future injection into the system of victims of the disease much as a farmer puts down pickled pork for summer use.

Sir Almroth E. Wright, of London, who has played a leading role in establishing this new system of vaccine treatment, wanted to call the sterilized suspensions of bacteria "vaccines;" but as vaccine is so thoroughly identified with the preventive treatment of small-pox, and is, moreover, prepared in an entirely different manner, the name "bacterins" has been proposed, and, in fact, is being used, for the Wright treatments. The Wright system already comprises a number of bacterins for the treatment of localized and chronic infectious diseases, including typho-bacterin for the treatment of typhoid fever, tuberculin, for the treatment of tuberculosis, strepto-bacterin, for the treatment of abscesses and cystitis, and coli-bacterin for the treatment of cystitis, fistula, catarrhal jaundice and various local infections. In all the treatment consists in injecting killed bacteria with the intention of increasing the formation of bodies or substances in the blood of the patient that will increase its power to throw off disease germs.

The bacterins differ essentially from the antitoxins. Diphtheria antitoxin acts immediately to neutralize the poison of the disease in the body of the patient, who is passive in the matter, affording the antitoxin no assistance. The bacterins, on the other hand, are incapable of influencing the disease germs. Their function is to stimulate the immunizing machinery of the patient and thus make it produce substances that will destroy the bacteria. In this case the patient himself plays an active part in the process.

In the first series of 83 cases in which this new remedy was tried there were only eight deaths, or 9.7 per cent, a record without parallel in the annals of medicine. This is all the more extraordinary because 34 of the cases were of alcoholic pneumonia, in which the mortality is very much higher than in non-alcoholic cases, ranging from 41 per cent in one series of cases studied to 45.5 per cent in another. Yet of these 34 cases but six died, which was only 17.7 per cent as compared with 41 to 45 per cent. In the other 49 cases, in which the patients had not been addicted to alcohol, but two died. Fifteen per cent of these cases reached the crisis of the disease in three days, an exceptionally short time. Dr. Timothy Leary, in speaking of these cases, said:

"Rapid relief followed the use of the vaccine; and in the case of uncontrollable delirium the abatement of delirium was prompt."

This success was so extraordinary that certain public spirited citizens of Boston, whose names are not given, were moved to establish a fund to furnish the pneumococcus vaccine

to any physician in the state of Massachusetts for the treatment of pneumonia. Upon application a bottle containing ten cubic centimeters of the vaccine is sent by special delivery mail to the physician. Full directions accompany the package, which includes a hypodermic syringe and a sterilized glass jar in which to return sputum from the patient from which to prepare an autogenous vaccine for the further treatment of the case.

More extraordinary yet was the experience of Dr. Henry A. Craig, Assistant Physician at Sailors' Snug Harbor, on Staten Island, with the new treatment. He tried but six cases, and physicians do not usually attach very great significance to so small a number of cases. The circumstances surrounding these, however, are so very unusual that they deserve consideration.

In the first place two out of every three old sailors who had been seized with pneumonia in the four preceding years died. In the last six cases all recovered, yet all were over 60 years of age and, to make matters worse, some were hard drinkers. In fact one man 78 years old, had been on a long drunk in the course of which he had undergone severe exposure to wet and cold. He had been sick for several days when he reached the hospital. Both lungs were badly affected. On top of all this he was anemic, and arteriosclerosis, or hardening of the walls of the arteries, was marked. According to all the rules of the game he should have died shortly after being admitted.

But Dr. Craig gave this apparently hopeless case an injection of 35,000,000 killed bacteria, followed 48 hours later by a second injection of 25,000,000 more and a third of 50,000,000 after the lapse of a second period of 48 hours. The patient's temperature dropped nearly to normal on the eighth day; his convalescence was rapid, and on the fourteenth day he was out of bed.

Another patient 83 years old had been on a protracted spree from the effects of which he was on the verge of delirium tremens when he reached the hospital with a very bad case of pneumonia. He was so far gone, in fact, that stimulants had to be administered to keep him up until the vaccine could be prepared and administered. Yet after having 50,000,000 dead bacteria injected into his system he recovered so rapidly that he was out of bed on the eighth day and has remained well since. A younger patient, only 67 years of age, whose habits were more exemplary, also responded to the bacterin treat-

ment and was out of bed in eleven days. The other three cases recovered quickly, too.

The method of treatment followed at Sailors' Snug Harbor was to give a hypodermic injection of 20,000,000 to 35,000,000 killed bacteria left over from a previous case as soon as the case was diagnosed as pneumonia. The next step was to prepare an autogenous (self-produced) culture from the patient's sputum. The pneumonia germs were rounded up and cut out from the rest of the herd and corralled in the feeding pen—inoculated, the doctors call it—which was a glass tube filled with calcium-salt agar. The contents of the tube were then poured into a Petri dish and incubated at a temperature of 98 degrees Fahrenheit for 18 to 24 hours, at the end of which time tiny dew-drop-like colonies of pneumonia bacilli could readily be distinguished from the colonies of other bacteria.

The disease germs were again cut out and put into fresh tubes of calcium-salt bouillon and incubated for 18 to 24 hours at a temperature of 98 degrees. By this time a suspension of large numbers of pneumococci were obtained in the bouillon in pure culture. Microscope slides were smeared with bacilli together with blood as an index, the smears were fixed with alcohol and stained with eosin and methylene azure. By taking a census of the bacilli on a number of microscopic fields a satisfactory estimate of the number in a cubic centimeter was obtained. The bacteria were then diluted with enough salt solution to bring the number of pneumococci to 50,000,000 per cubic centimeter. The deadly mixture was then sealed in glass tubes, each containing one cubic centimeter, or 50,000,000 bacteria, which were then killed.

Possibly antivivisectionists may be interested to learn that this wholesale massacre, instead of being conducted with a decent regard for the dictates of humanity, was accomplished with savage ferocity; for these hundreds of millions of germs were cut off in the heyday of youth by the most horrible of all deaths, that by slow fire. After being exposed to a temperature of 140 degrees Fahrenheit in a hot air sterilizer for 45 minutes the bacteria, now dead, were ready for use in doses of 20,000,000 to 50,000,000 bacteria by thrusting the hypodermic needle straight into the flesh instead of merely under the skin in some spot where they would be most readily absorbed.

Bacterin inoculation is based on Metchnikoff's theory that the successful resistance of an animal against bacteria depends upon the power of certain white blood corpuscles, known as phagocytes, to destroy the invading germs. This process of destruction is known as "phagocytosis." It has been demon-

strated by Sir A. E. Wright that this phagocytosis, that is, the power of the leukocytes to incorporate and destroy bacteria, depends upon substances in the blood to which he gave the name of "opsonins," from the Greek word "opsono," which means "I prepare for food." The opsonins contained in the blood serum combine with the bacteria rendering them capable of being taken up and destroyed by the phagocytes.

The measure of the power of the blood serum of an infected individual to prepare bacteria for ingestion by the phagocytes, as compared with serum from healthy individuals, is termed the "opsonic index." The opsonic index of healthy blood is taken as 1. For example, 100 leukocytes may ingest 500 staphylococci treated with healthy serum, while the serum of a person suffering from pustular acne may take up only 400. The opsonic index of the diseased one, therefore, would be 0.8. To ascertain the opsonic index of a patient a measured quantity of a bacterial suspension is mixed with equal amounts of blood serum and an emulsion of healthy leukocytes. The mixture is incubated for several minutes to permit the opsonizing action of the serum on the bacteria and to allow the prepared organisms to be ingested by the leukocytes. Microscopic slides are then made from the mixture and the number of bacteria in 100 leukocytes is counted. The information thus obtained is used to guide the physician in gauging the size of the dose of killed bacteria to be administered.

In discussing the new vaccine treatment, Wright, who naturally enough takes an optimistic view of his own labors, said:

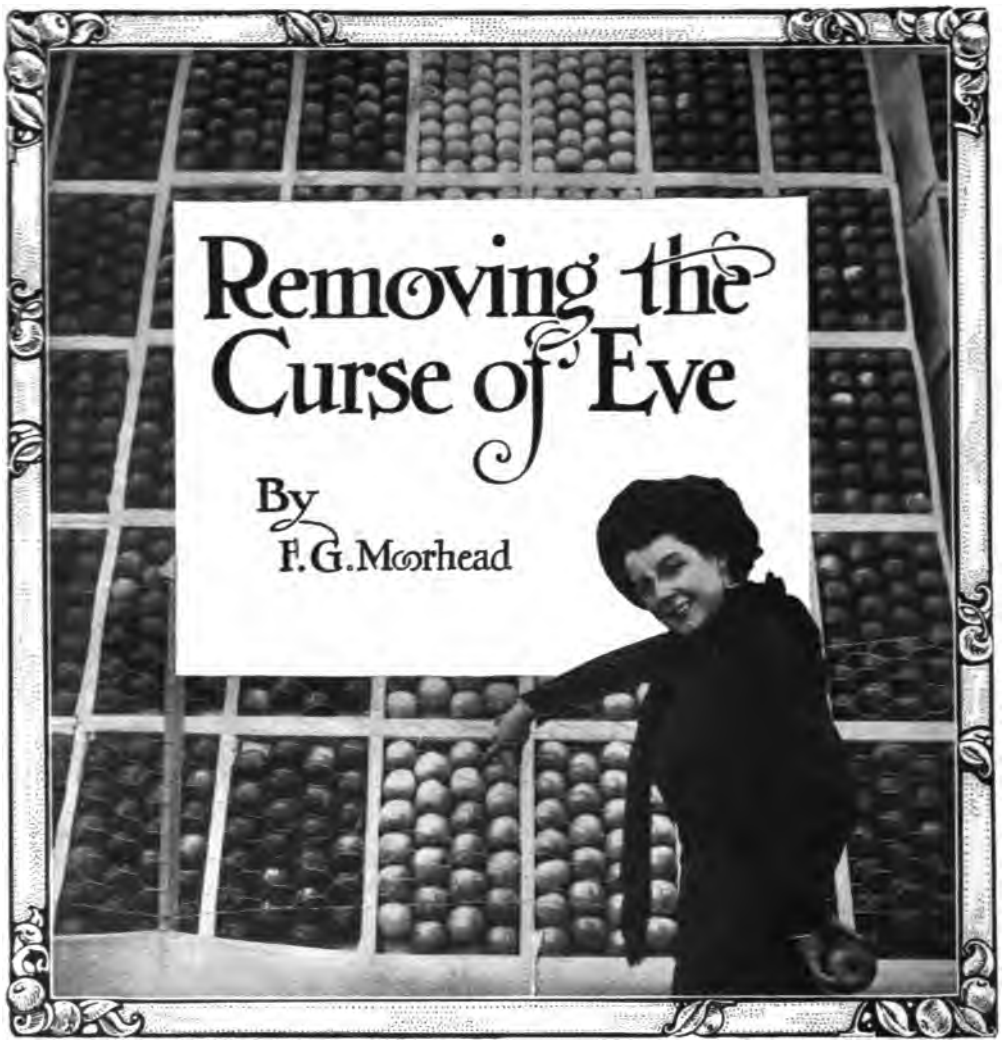
"We have, in the power of raising the antibacterial power of the blood by means of these bacterial vaccines with respect to any invading microbe, out of all comparison the most valuable asset in medicine. . . . It is not a question of success in a certain percentage of cases only, but up to the present time it has been a question of uniform success."

Other doctors, faithful to their traditions, do not agree with Sir Almroth; but they are, nevertheless, greatly interested in his system of "vaccine therapy."

At all events it is about time something was done, for as long ago as 1885 Fraenkel demonstrated that the pneumococcus bacteria was the almost universal cause of lobar pneumonia.

Dr. Seymour Taylor, M. D., F. R. C. P., Physician to the West London Hospital, in a lecture in 1907, said:

"Although we must admit that pneumonia is a specific disease, we have, as yet, no specific remedy. The profession is waiting for, and even demands, a successful antitoxin serum."



THE forbidden fruit of the Garden of Eden which brought sin into the world is now looked on as the means of driving sin out of the world. No less an august body than the Iowa State Horticultural Society is standing sponsor for the movement to remove the stigma from the apple.

When Eve, sorely tempted, partook of the luscious fruit which she had been forbidden to touch, she all unwittingly cast a blight on the apple which centuries of cultivation and two national shows at Spokane have been unable to remove. It has remained for an apple-loving country doctor to discover that not only can the world be fed until it has secured the necessary calories of energy, but that the craving for liquor—conceded to be the greatest cause of misery and crime—can be eradicated from the human body by the apple. As if this were not miracle enough, it is contended that General Grant might have won the siege of Vicksburg and the battle of Appomattox by munching on a Ben Davis, a Spitzenburg or a Jonathan, just as well as by puffing on a fat black cigar.

"The use of apples as an article of diet will very much diminish, decrease and ultimately abate the appetite for alcoholic stimulants," declares Dr. Samuel

Bailey of Mt. Ayr, Iowa. "That this is a fact could be proved in many instances if a little care, caution and vigilance were taken to thoroughly investigate conditions. As a rule the habitual user of alcoholic stimulants is rarely a lover or consumer of apples. There seems to be a peculiar combination in apples, in the acid in them, or in the peculiar chemical combinations of the apple, that allays the irritation, or so-called appetite, produced by the use of liquor. I am also of the opinion that the keen appetite for tobacco is limited by the use of apples. I am thoroughly convinced that any man who is a lover of whisky and is in a condition when he thinks he must have a drink, if he will eat an apple before he takes the drink, will find that his appetite for the drink has been materially lessened, if not entirely abated for the time.

"I would like to have you gentlemen make careful examination and extensive inquiry and find if any one ever saw in a grog shop or saloon or any other place where intoxicants are sold or consumed that apples were placed in convenient access for use as a free lunch. I have never heard of such a thing. Instead of apples as a free lunch in a saloon you will find all kinds of richly spiced, salted and peppered foods, just such foods as will stimulate the appetite for intoxicants. If this use of apples can become a settled fact with the masses the field for the usefulness for the apple is just beginning to open. I am a firm believer that apples and intoxicants never go together, that they are antagonistic, and further that the time will come when the scientific, economic and sociological world will recognize this, the greatest function and mission of apples."

Fortunately for the cause of prohibition the apple crop of 1909 was something like 4,000,000 barrels larger than that of 1908. Figuring 200 apples to the barrel, there were enough apples grown in America last year to stop five and one-half billion people from taking one drink each, or to keep the entire population of the United States from taking a drink for two months and a half, assuming that one apple substitutes for one drink and that every man, woman, and child felt impelled to take one drink a day.

That Doctor Bailey's views were approved by the Iowa State Horticultural Society, before which they were originally expressed, was evident by the applause at the time and subsequently by the action of the state secretary, Mr. Wesley Green, who has called on Dr.

A TEMPTING DISPLAY.
Attractive enough to lure the habitual drunkard from the crooked paths he has worn deep.

H. W. Wiley, of the national department of agriculture, to carry on a series of experiments which shall determine the value of apples both as a food and as a drink substitute. "I am firmly convinced that Doctor Bailey is right," says Secretary Green. "It is a subject so important that the government should order experiments and the results be given to the world without undue delay."

DR. SAMUEL BAILEY.
This country physician says the apple is removing the curse of Eve.

Equally as important as the discovery that the apple is prohibition's greatest factor is the discovery that the apple is not merely an article of edible luxury but an edible necessity, capable of sustaining life, entitled to rank among the great staple foodstuffs of the world. Doctor Bailey points out that whereas the human body needs 2,000 calories of energy each day, the apple provides two-thirds as much of this motive power, this fuel to drive the brain and the body so that the work of the world will be done, as the potato, the staple daily food of millions of people, and one-fourth as much as the staff of human life, wheat bread. The ordinary apple is composed of 85 per cent. water, 14 per cent. carbohydrates, 0.05 per cent. protein and 0.03 per cent. mineral matter. The carbohydrates consist of cellulose, sugar and starch, the latter predominating. The mineral matters comprise malates of sodium, potassium and phosphates. In the ordinary digestive process of apples the salts and water portions are absorbed by the stomach, the intestinal juices act on the starches and sugars and also digest to some extent the cellulose. If the apples are cooked the cellulose granules are broken up and the starch is liberated, thus making these ingredients more assimilable.

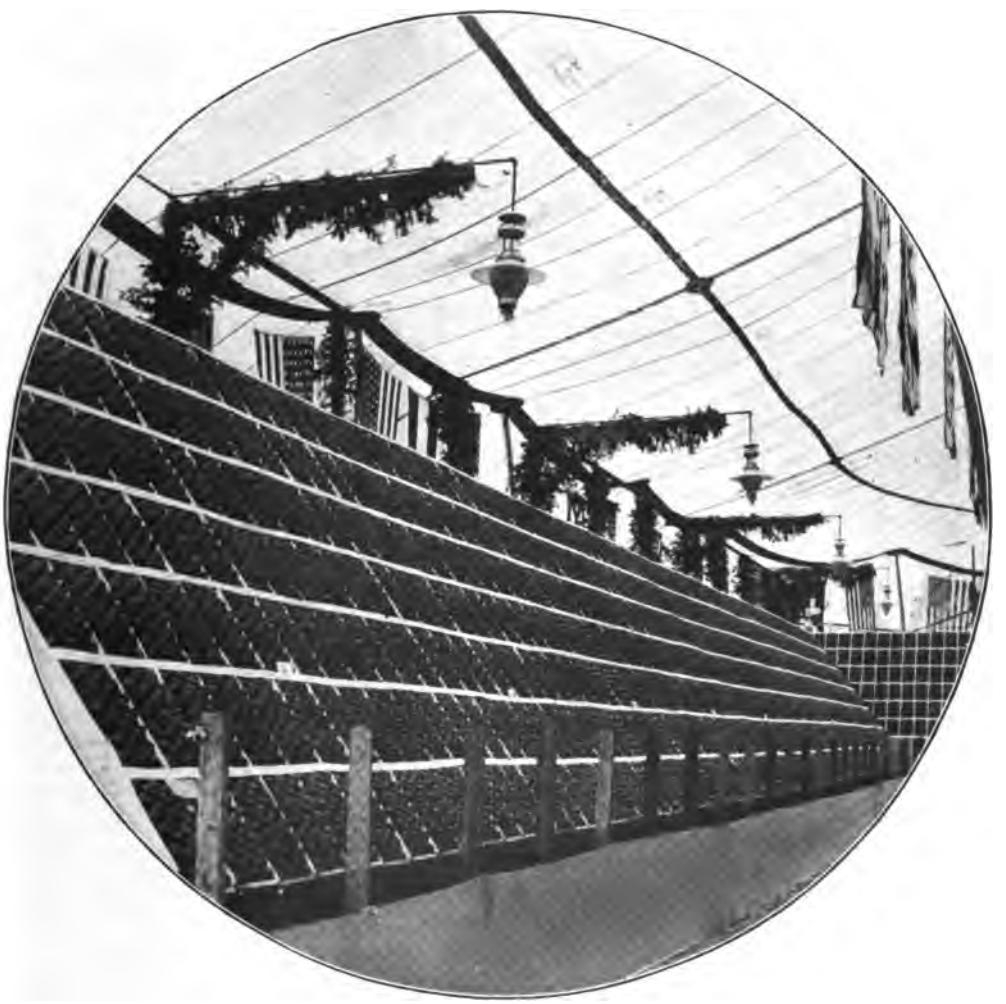
"As to the actual value of apples as food," explains Doctor Bailey, "we can only arrive at that by estimating the energy produced by their consumption. An ounce of apples will give about 18 calories of energy, comparing favorably with potatoes, which give 24 calories of energy to the ounce, and with bread, which gives 70 calories of energy to the ounce. Roughly speaking, therefore, four ounces of apples are equal to one ounce of bread. An ounce of cabbage will furnish 3½ calories of energy, so that the food value of the apple is about six times that of cabbage.

"The value of apples as a food is not to be measured solely by their concentration. They are valuable as roughage in the stomach. They furnish a considerable amount of indigestible matter which is valuable in stimulating intestinal activity and preventing constipation. It would take enormous quantities of apples to furnish the 2,000 calories of energy needed each day, but it is necessary to add the apple and other foods of low values to obtain bulk in the diet, just as horses are fed hay with their grain to make the diet bulky. For this purpose and particularly in these modern days when food supplies are highly concentrated and especially prepared it is important that these bulky substances such as apples, cabbage, etc., should be added to the diet. Apples in particular are of value. They are easily digested and are a fresh food; they supply mineral salts in abundance and also vegetable acids which are exceedingly valuable. No apple eater will ever have scurvy, nor will he have constipation, which has become one of the great plagues to harass and worry the higher grades of our civilization."

It is important to note, in this connection, that the danger of the world having its apple supply reduced is not so great as it was a year ago, for the 1909 crop of the United States was 27,000,000 barrels, as compared with 23,025,000 barrels the preceding year. The 1909 apple crop was sufficient to generate more than a trillion calories of human energy. In other words, if all the apples grown in the United States in the past year had been consumed as food they would have supplied all the necessary energy for one man for 1,500,000 years or for a million men for a year and a

half. And inasmuch as America has already proved that it can raise 60,000,000 barrels of apples a year—the yield fifteen years ago—the prospects of energy calories being lacking, so far as the apple can assist in their production, is rather remote.

American horticulturists thus confront a triple situation: they can feed the world energy-producing food that will eradicate disease; they can give the prohibitionists a sure cure for drunkenness, which is said to be the cause of most of the crimes of humanity; and they can incidentally reap a nice profit for themselves. How nice this profit is, a few instances suffice to show. One orchardist reported for the 1909 season that twenty trees of Snow apples yielded 712 boxes, or more than thirty-five boxes to the tree. The apples sold at $1.50 a box, the twenty trees in one season returning more than $1,050. The son of a Western orchardist, who owns one row of trees in his father's orchard, paid his year's college expenses from the returns of his row of trees and at the end of the year had a balance left in the bank. The row yielded 500 boxes of apples, which sold at $1.60 a box. It is needless to add that the row was well cultivated, careful attention being paid to



IF APPLES ACTUALLY DO REMOVE THE CRAVING FOR ALCOHOL, THIS ARRAY SHOULD KEEP A TOWN "DRY" FOR A WEEK.

all the details of scientific orcharding. Spraying the trees twice a year and keeping the ground clear of weeds is the recipe that a Missouri orchardist used to raise a large crop the past year. In this orchard are twenty-five acres, three-fourths in the Ben Davis variety and the remainder in York Imperial and Jonathan apples. The year's crop was about 3,600 bushels, which brought $1,980 at fifty-five cents a bushel, an average of $80 an acre. Far more profitable acres are reported by orchardists who have brought their trees to a high state of cultivation and by making a specialty of the finer varieties and grades have reaped a harvest of several hundred dollars from an acre.

But aside from all questions of financial profit there is the good work to be done in removing the Eden-inherited stigma from the king of fruits. America is practically the only country which does not import apples. It has never done so. On the other hand it exports millions of barrels each year. The day may not be far distant when the American-grown apple will follow the flag and the constitution around the world, bearing on its wrapper the formula for the eradication of hunger and crime, through the gentle pastime of apple-munching. It will be another case of liberty enlightening the world and for the first time in all the aeons Eve can rest in her grave, her mind unperturbed by the worry of having given sin to the world because of her appetite.

The Serenade

I arise from dreams of thee
In the first sweet sleep of night,
When the winds are breathing low,
And the stars are shining bright.
I arise from dreams of thee,
And a spirit in my feet
Has led me — who knows how?
To thy chamber-window, sweet!

The wandering airs, they faint
On the dark, the silent stream—
The champak odors fail,
Like sweet thoughts in a dream;
The nightingale's complaint,
It dies upon the heart,
As I must die on thine,
O, beloved, as thou art!

—SHELLEY.

WIND TURBINE FOR PUMPING FOR IRRIGATION. A device for stealing electric power from the atmosphere.

WIND TURBINE FOR ELECTRIC LIGHTING AND VENTILATING, AND FOR COOKING, IN A TROPICAL BUNGALOW.

HOUSEKEEPING BY WIND-POWER

By

HENRY M. HYDE

TO solve the servant problem!

To cut down the cost of living!

To make housekeeping modern and scientific!

Electricity!

The simple and scientific household of the future will depend entirely upon electricity for heat, power and light. For the past year or two many electrical appliances for household use have been on the market.

Among them are electric coffee percolators, toasters, egg boilers, and a dozen other pieces of apparatus for use in the kitchen; electric grates, curling iron heaters, bed warmers, and even bath-robes; washing and sewing machines driven by electricity; electric door mats, by stepping on which one opens the door; electric signals, elevators, and almost innumerable other conveniences.

These electric appliances have not as yet found any large use in the average household, because, added to their—comparatively—large first-cost is an even larger regular monthly charge for electric current.

From England comes the report of a discovery which will permit electric companies to furnish current at greatly reduced rates, thus putting the use of electric household appliances within the reach of many families. One of the reasons why electric current has heretofore been so costly lies in the fact that the amount of current consumed at various hours of the day varies greatly. In the evening, for instance, when a great city is turning on its electric lights the current consumption for a few hours may be twenty or even one hundred times more than during the middle of the day. A similar difference on a small scale may be found in the individual house, when instead of a single light burning in a dark closet, a score or more of the incandescents may be turned on at once and the whole building illuminated. As a consequence of this widely varying demand for current the electric power companies are obliged to in-

A WIND-MILL ELECTRIC GENERATOR.

WIND-MILL DISPLAY AT AN ENGLISH ELECTRICAL SHOW.

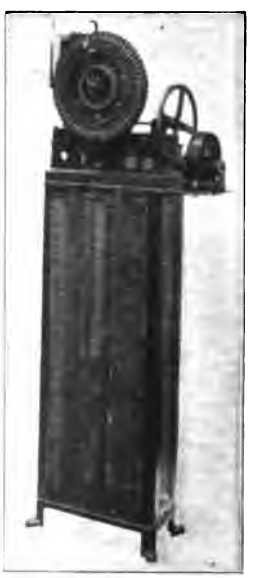
stall plants large enough to take care of the maximum amount which may be required. At the same time they are able to use this maximum amount of current for only a few hours out of each twenty-four. During the rest of the time a great share of the machinery must lie idle, unless, indeed, the surplus current is taken care of by storage batteries—a practice which has not heretofore proved entirely satisfactory. The rates to the average householder for electric current are therefore based on his maximum requirements. He really pays very much more for the power he uses than if he demanded a regular and constant supply of power during the whole twenty-four hours.

The English invention is a device for storing heat produced by electric current. The device itself is a metal cylinder of no great size which is used at the same time as a water heater. By turning a single tap at the top of this cylinder, water can be obtained at any desired temperature, from tepid to boiling. When the electric current is desired for any other purpose, such as cooking, or lighting, or running a small electric motor, the current is automatically shut off from the cylinder. When the cooking is over or the lamp and motor are turned off, the current automatically runs back into the water heater. By the use of this device the consumer is able to contract for the regular and constant use of the same amount of electric current during the whole twenty-four hours. So effective is the heat storage apparatus that less than ten per cent of the stored-heat is dissipated during eight hours.

ENGLISH WIND TURBINE IN SERVICE FOR FLOUR MILLING.

ELECTRIC LAMP PLATE WARMER AND EGG POACHER.

Although only introduced in London during the past few months the new device has already proved popular with the individual householder and with the electric power companies. The householder putting in one of these heat storage devices is able to contract with an electric power company for a certain regular supply of electric current at a fixed price per month.



AN AUTOMATIC REGULATOR FOR THE DYNAMO.

The power companies are able, because of the fact that the demand for power is regular and constant, to make a price so low for current, that in many instances the consumer has been able to light his house, get an abundant supply of hot water and do a large part of his cooking, washing and other household work for a sum not much larger than he previously paid for electric lights alone.

But in the dreams of English engineers there has lately dawned an even brighter day for the housewife and the home maker. Having arranged by means of the heat storage cylinder, to greatly cut down the cost of electric current, they now plan to give every householder—at least those whose establishments are of considerable size—an exceedingly economical electric power plant of his own.

Heretofore electric current has been generated chiefly by the burning of coal under steam boilers. More recently, the power developed by rivers and water falls has been utilized. But big corporations are more and more monopolizing the water powers and in any event no private person could afford to install a plant for developing hydro-electric power for his own use.

The English engineers take advantage of the wind which bloweth where it listeth over all the surface of the earth. Not even the most far-sighted and ingenious trust manager has ever been able to devise any scheme for monopolizing the wind. Already on many English country places wind-mills have been set up, the power from which is used in operating a dynamo. To provide a surplus of power for use in calm weather a storage battery is also provided. Mr. Edison's new storage battery, which promises great things in the way of economy, will doubtless be utilized in this direction. With the plants already established—some of them also being furnished with auxiliary gasoline engines for use when the wind is not blowing and the storage battery is exhausted—sufficient electric current to heat and light a large country house with its outhouses and to furnish power for all desired purposes is developed at a cost of about one-third of the rate charged by the commercial companies.

A number of manufacturing corporations in England have also established wind turbine electric generator plants at their works and are getting power enough not only for lighting and heating their factories but also for the running of a considerable portion of the machinery.

SUCCESSFULLY USED ON AN ENGLISH FACTORY FOR LIGHTING THE WORKS.

AN ELECTRIC HEAT STORAGE DEVICE—AN ENGLISH INVENTION.

AN ELECTRIC IRONER FOR HOME USE.

The wind-mills for this purpose are so arranged that when the wind rises beyond a certain speed the wheel is automatically turned away from its working position. In this way the wind-turbine plants may be left without attendance. It will work if it is in the strongest gale.

In the not remote future the engineer sees every householder with a windmill in his back yard, from which, at a very small cost, he will get electric power sufficient to light and heat his house and to perform all the work in which electricity can be utilized. It is certainly in this direction that the greatest progress will be made in putting housekeeping on a scientific basis. Coal, soot, ashes and all the labor connected with them will be abolished. By the simple turning of switches, most of the ordinary household tasks will be performed, and that which is now drudgery will become, if not a pleasure, at least an interesting task.

Sweet Remembrances

Let Fate do her worst; there are relics of joy,
Bright dreams of the past, which she cannot destroy;
And which come in the night-time of sorrow and care,
To bring back the features that joy used to wear;
Long, long be my heart with such memories filled;
Like the vase in which roses have once been distilled,
You may break, you may shatter the vase, if you will,
But the scent of the roses will hang round it still.

—MOORE.

PURE MILK AT LAST

By

CHARLES FREDERICK CARTER

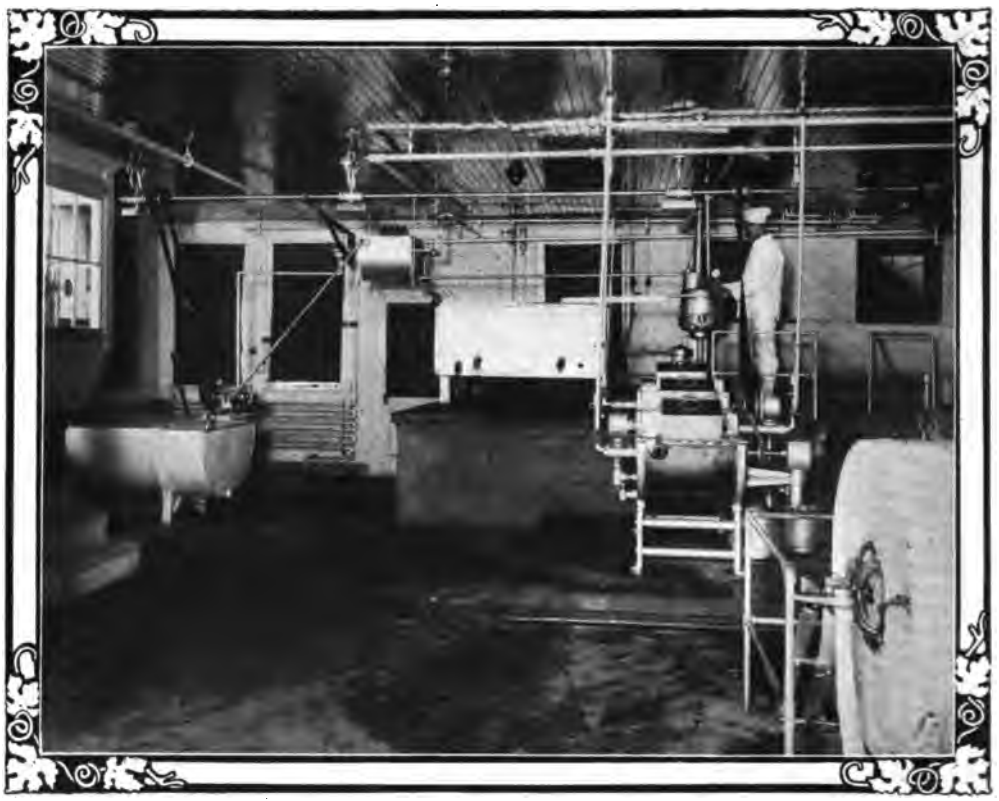
BECAUSE a little girl in New York City had the misfortune to contract a disease from filthy milk four years ago, clean, pure, wholesome milk has been placed on the market for the first time. When the doctor told the little girl's papa, who was A. J. Baldwin, a lawyer, that the swelling on his daughter's neck had been caused by filthy milk the lawyer determined to find out the causes of impure milk and the reason why it was not purified before being sent to market.

When he had informed himself concerning milk the lawyer had such uncomfortable qualms in the region of his stomach that he almost regretted his research, for it is far from nice. The revelations about packing house methods four years ago sound appetizing when compared with the secret history of a can of milk.

Next to meats, cereals, cotton and hay, milk is the most valuable of farm products, amounting in round numbers to hal' a billion dollars a year. The annual consumption of milk in the United States today is seven billion gallons, and it is increasing more rapidly than population. Yet the methods of handling this important food product on the average farm are disgusting. Frequently the cow's udder is encrusted with mud or barnyard filth which drops into the pail during the process of milking. On warm days perspiration

A Model Barn Where Clean Milk is Assured.

The First Step in Preserving the Purity of Milk.
Milking in a sanitary stable.



TREATING MILK. IN THE COUNTRY. WITH CARBONIC ACID GAS.

from the milker's hand trickles on to the teat where it mixes with the filth, forming a thin paste which also drops into the pail. Besides all this, the milk has a strong animal odor, or musk, which is decidedly offensive to most folk until the palate has become hardened to it.

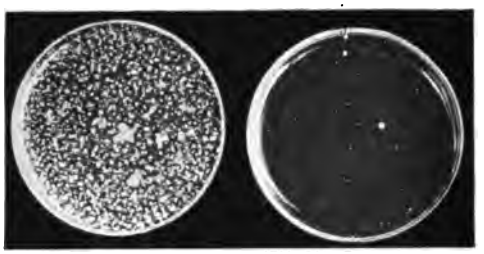
Mere filth is of secondary importance, however.

Of all food products milk is the most favorable medium for the growth of bacteria. For this reason it is used in all bacteriological laboratories as a test substance for the growth of disease producing germs. If typhoid, tuberculosis or diphtheria germs get into the water supply of the herd they will appear in the milk. Beside this, disease producing bacteria exist everywhere, in the dust of the barn, the dairy, the home, and wherever milk is handled. If a few typhoid germs get into the milk from any source they increase so rapidly that in twenty-four hours they are multiplied into enough poison to kill a score of persons.

THE RIGHT SORT OF MILK SHIPPING CANS.

Even if the milk escapes contamination until it gets to the dairy it is there strained through germ infected muslin, so danger is strained in and not out. The milk is then put into a

MILK KEPT EIGHTEEN HOURS AT BLOOD HEAT.
Untreated specimen on left—14,000,000 bacteria per cubic centimeter; treated on right.



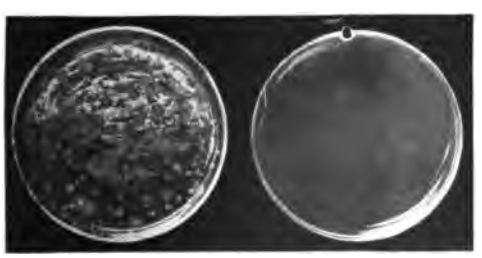
MILK KEPT THIRTY-SIX HOURS, AT TEMPERATURE OF ROOM.
Untreated specimen on left—300,000,000 bacteria per cubic centimeter; treated on right.

can that, not having been properly sterilized, contains more germs. If it gets to the city in fairly good condition still more germs will be added during the bottling process; and by the time the milk is used it is literally swarming with bacterial life. Twenty samples of milk taken from cans on arrival in New York averaged five million bacteria per cubic centimeter. Ten samples collected at the railroad station in Philadelphia averaged four million eight hundred thousand bacteria per cubic centimeter. Nineteen per cent of the milk arriving at Boston averages more than a million bacteria per cubic centimeter, while 58 per cent averages more than a hundred thousand.

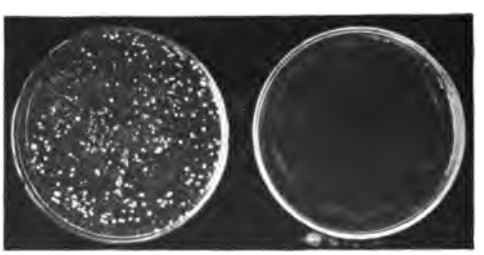
People drink this awful stuff, die of typhoid fever, diphtheria and other filth diseases; the survivors lay the blame on Providence, drink milk and in their turn are prematurely gathered to their fathers.

But two safeguards have been devised. One is pasteurization, which consists in heating the milk to 167 degrees Fahrenheit for a short time, then cooling it quickly. As carried out in the laboratory this process kills a good many of the germs, but not all; as carried out commercially pasteurization is a farce, and in the case of unscrupulous dealers is nothing less than an added source of danger. The only remaining safeguard is found in a plan devised in 1890 by the Medical Society of New Jersey by which milk is produced under the supervision of a medical commission which must approve the methods of handling milk and the condition of the herd as sanitary. If the milk contains no more than thirty thousand bacteria per cubic centimeter it is "certified." Even this half measure is not the success it should be on account of the extra care and expense involved. Of all the milk sold in the United States not more than five per cent. is pasteurized and barely one per cent. is certified. In any case milk can not be preserved for any length of time but must be rushed to market and consumed promptly or it spoils utterly.

Having grasped the situation Lawyer Baldwin set himself the task of finding a germicide that would at least render



YEAST.
Untreated specimen, showing marked growth of the yeast, on left; treated specimen, on right, showing no growth in yeast after ten days.



MILK KEPT TWO WEEKS STERILE IN REFRIGERATOR.
On left, untreated specimen, 500,000,000 bacteria; on right, treated specimen.

TREATING THE MILK DOES NOT CHANGE ITS PROPERTIES.
That on left—treated—has as much cream as that on right—untreated.

milk reasonably safe, and also, if possible, some method of preserving it for a few days. He experimented with every known germicide and method of preservation. Then he employed bacteriologists and chemists to continue the search for an effective method of destroying disease germs in milk. Such experts come high; and Lawyer Baldwin was getting small returns for large expenditures.

One day he was talking of his hobby, pure milk, to his friend, James F. Lester, a bottler, who, in return, regaled the lawyer with a disquisition on his hobby, which was carbonated beverages.

"Did you ever try carbonic acid gas on milk?" asked the lawyer.

"No."

"Then try it."

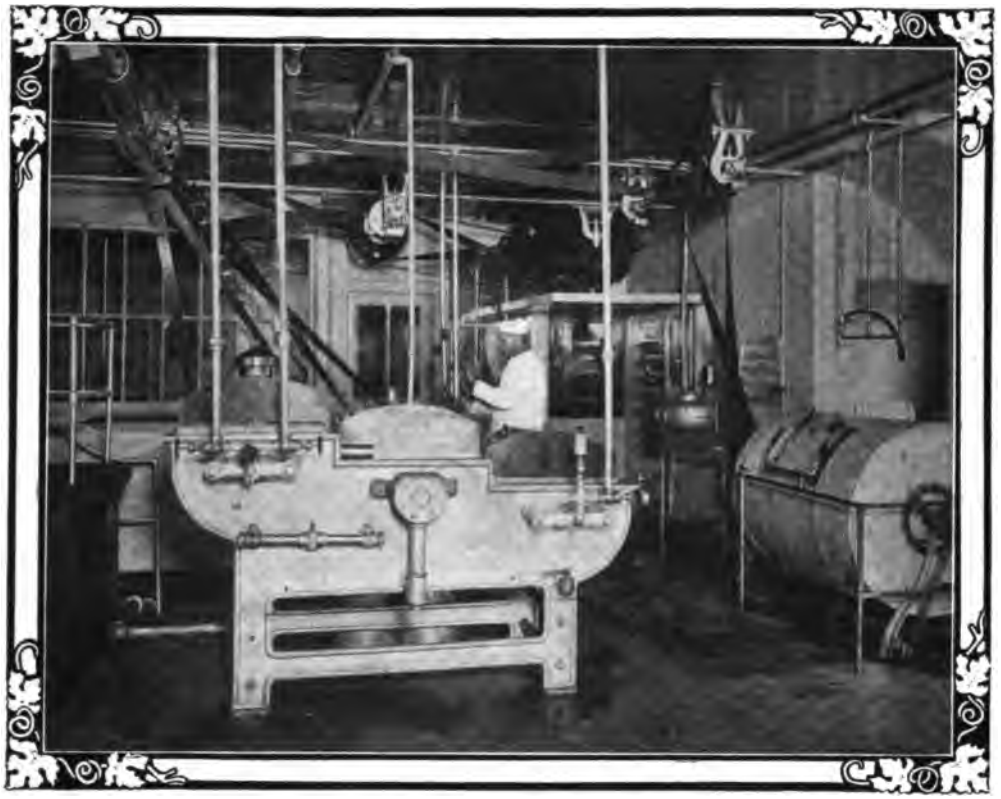
Lester did try it as soon as he could get back to his bottling establishment. Next day he took the bottle of carbonated milk to Baldwin, who passed it on to the bacteriologist. When he received the laboratory report Baldwin became as excited as a dignified attorney with a large practice may properly become. It is needless to repeat what the bacteriologist said because his report was couched in such profoundly scientific phraseology that he probably did not understand it himself; but the purport of it was that there had been a St. Batholomew's Day, so to speak, among the bacteria in that bottle.

At last a way had been found to purify milk.

Anyway, that is what Messrs. Baldwin and Lester thought for a few blissful hours. An awakening came later, for Baldwin and Lester were destined to make anew the discovery so many thousands had made before them: that between the birth of a valuable idea and the commercial utilization thereof lies a great gulf that can only be bridged by tireless labor and lavish expenditure.

But they stuck to the task until they worked out a practical method of carbonating milk, which kills the germs and preserves the milk until it is wanted, and of decarbonating it for use. By the time they were ready to deliver the first quart of Apathogenic Milk, as the product of the Baldwin-Lester process is called, from the experimental dairy at East Orange, New Jersey, they had paid out the neat little sum of $25,000. Expenditure is not at an end, for the chemists and the bacteriologists and other technical experts are still at work in an endeavor really to master the whole subject.

TREATED MILK SIX MONTHS OLD. UNCHANGED AND STERILE.



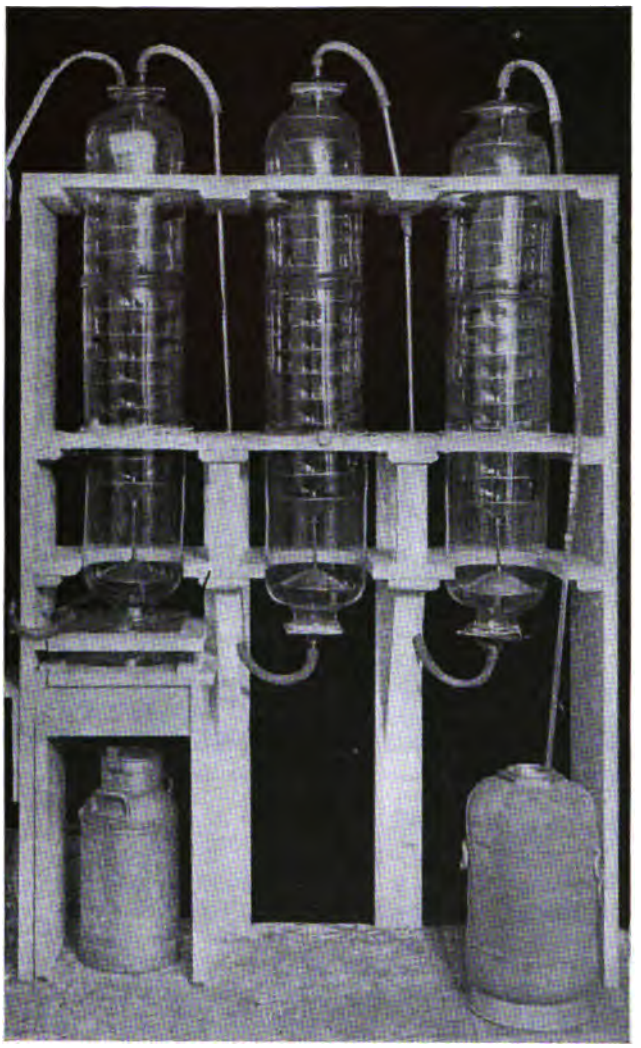
WHERE THE MILK HAS ITS GASES REMOVED.

The Baldwin-Lester process for rendering milk apathogenic is simplicity itself. It begins with the cleanly production of milk, which means that only healthy cows are to be kept, and that their udders and flanks and the milkers' hands are to be washed before milking. The milkers use covered pails of a special pattern to protect the milk from dust and germs in the air. So far this is no more than should be done everywhere regardless of whether the milk is to be carbonated or not.

MILK AS IT APPEARS AFTER AND BEFORE DEGASIFYING.

After the milk has been drawn, instead of being strained and cooled, a necessity under the old conditions, and a procedure that generally introduced more dirt than it took out, it is left in the milking pail or poured directly into a sterile can until it is treated with gas. This method lightens the work of the farmer instead of increasing it as in the case of certified milk.

Next comes carbonating, which consists in introducing into the milk carbon dioxide, or carbonic acid gas. This may be done at the farm dairy, as the apparatus is extremely simple, or it may be done at a central creamery. Carbonic acid gas is what gives life, sparkle and



GLASS DEGASIFYING APPARATUS.
The milk passes over a series of disks in a vacuum.

zest to champagne, beer, ginger ale, Apollinaris and all other mineral waters, whether natural or artificial, and soda water. The business of manufacturing carbonated beverages has grown to enormous proportions. Bottled carbonated temperance drinks alone of the wholesale value of $30,251,150 were manufactured in 1905 as compared with $23,268,876 in 1900. Every drug store and candy shop has its soda fountain which is sure to be well patronized. All this goes to show that carbonic acid gas is very popular as an addition to a beverage. When taken into the stomach it is considered healthful, though it cannot be recommended for breathing purposes. To meet the great and steady demand carbonic acid gas is manufactured in enormous quantities and can be had in tanks at moderate pressure, or in cylinders at high pressure, very cheap anywhere within reach of a transportation line.

For carbonating milk a forty quart tank built to withstand a pressure of one hundred pounds per square inch is first filled with carbonic acid gas at seventy-five pounds pressure from an ordinary gas tank such as is used for making soda water. The warm milk is then pumped through a cooling coil into this gas filled tank under pressure, the effect of the operation being to mix the gas with the milk thoroughly. The milk is now in a perfectly sanitary, sealed shipping can ready to be sent any distance after only two handlings as compared with half a dozen handlings under the old methods. As the gas acts as a preservative it is not necessary to use ice in shipping even in the hottest weather.

In fact the effectiveness of carbonic acid gas in preserving milk, one of the most perishable of food products, is marvelous. In laboratory experiments carbonated milk stored in a refrigerator at a temperature of forty-three degrees, Fahrenheit, at the end of four months contained no bacteria and was but very slightly altered in taste. It was still perfectly good for use. At the end of seven months the milk was still normal in appearance and contained no bacteria. Untreated milk in the same refrigerator spoiled in three weeks. It would be en-

tirely practicable to supply a vessel with carbonated milk enough to last for a round trip to Europe, or to South America, or around the world, for that matter. The last quart would be just as fresh and pure as when it was carbonated.

On reaching the city the milk is allowed to flow down over a series of convex disks in a vertical cylinder in which a vacuum is maintained. This removes the gas and the milk is thus restored to its natural fresh condition. It is immediately run into bottles of a type not used before for milk and sealed with an airtight cork crown such as is used on beer and mineral water bottles.

As a beverage milk need not be degasified. Carbonated milk is merely glorified vichy and milk with an extra tang and sparkle highly agreeable to many palates.

Thorough and repeated tests by different bacteriologists have proved conclusively that 99.9 per cent of typhoid, diphtheria and all other disease germs that can be segregated and identified are killed after twenty-four to forty-eight hours in carbonated milk. Moreover, the objectionable animal odor and taste are also removed, so that those to whom ordinary milk is distasteful can drink apathogenic milk with a relish.

Dr. Elmer S. Newton, A. B., M. D., of Washington, who made a chemical study of milk treated by the Baldwin-Lester process, reported that it was perfectly normal so far as chemical examination could show. Artificial digestion experiments showed it to be as digestible as ordinary milk. A number of young children were fed apathogenic milk for several weeks. They all flourished and were free from digestive disturbances which so frequently accompany the use of ordinary milk, and one that was in an almost dying condition made a remarkable recovery on apathogenic milk.

Not the least attractive feature of the new process of handling milk is its cheapness and simplicity. The milk may be treated on the farm if there is a supply of steam convenient for sterilizing cans and other utensils. The only apparatus required is a hand pump, a coil of tinned copper pipe to be used as a cooling coil, and a tank of some kind to accommodate this coil. The only other requisite is a sufficient number of pressure cans which are made to withstand a pressure of 75 pounds. The carbonic acid gas may be obtained in cylinders. The cost of milk treated is but a fraction of a cent per quart.

If treated on a large scale at a central point, such as a creamery, all that is required is a covered receiving tank and a power pressure pump. The degasifying apparatus used in the city is a very simple thing that may be readily cleaned and sterilized. Bottling machines for filling and sealing the bottles with the crown seal run by foot or steam power are also inexpensive.

THE HOUSE-FLY AS A CROP-WRECKER

By

ROBERT E. BENTON

MUCH has been written and printed of late about flies as a menace to human health. But not a word has been said about the damage they do to cultivated crops, which, in this country, must amount to scores of millions of dollars annually.

Nearly all diseases of plants are due to fungi, usually microscopic. Of such character, for example, are the "smuts" of wheat and other grains, the "mildews," the "rusts," and all the long list of fruit "rots" of various kinds. These and ever so many other vegetable maladies are attributable to minute fungi which feed

DISCOVERING THE WHY AND THE WHEREFORE.
Studying cultures of fungus plant diseases at the Plant Bureau in Washington.

upon, and in a very brief time ruin, the plants.

The fungi in question are distributed in a number of ways, but commonly by flies—that is to say, by the Muscidæ and Sarcophagidæ, or, in other words, the house-fly and its relatives, and the carrion flies. Those insects feed on almost everything imaginable, and, constantly flitting from place to place, are the universal distributors of the "spores"—corresponding to seeds—of all kinds of fungi.

Dr. N. A. Cobb, of the government plant bureau, who has made a very painstaking study of the subject, counted 700,000 such spores which were left behind on a single footprint of one fly. In like manner, with the aid of a microscope, he counted in one fly-speck 2,400,000 fungus spores. Thus it is seen how extraordinarily efficient flies must be as carriers and planters of disease-producing fungi. They scatter them everywhere, and are the chief agents for spreading the maladies most destructive to the farm, the garden, and the orchard.

Of Course This Formidable Fly Is An Artificial One.

If a fly-speck on a window-pane be closely examined, threadlike "rays" are likely to be found extending from it in all directions. These are usually due to the growth of fungi. Dr. Cobb collected from such specks more than twenty different kinds of spores, representing as many species of fungi, and fed them to flies. He found that they passed through the bodies of the insects uninjured, retaining all their vitality, and thus remaining in condition to "sprout" whenever opportunity might serve.

Anybody may verify this experiment for his own satisfaction by feeding a fresh-caught fly on the common "blue mold," which is so frequently found growing on cheese, or bread, or old shoes that have

THE HOUSE-FLY IS A GREAT DISTRIBUTOR OF FUNGOUS DISEASES OF PLANTS.

been exposed to dampness. If a very small quantity of this mold be mixed with a drop of sweetened water and put into a bottle, together with a fly, the latter will drink the water, and specks will soon be deposited on the glass. In a moist atmosphere, at living-room temperature, within forty-eight hours every such speck will bloom out with a luxuriant growth of blue mold.

A good many diseases of plants, caused by bacteria, and not by fungi, are known to be distributed by flies. This is true, for example, of the deadly "pear blight," which might be called a fly malady. When it runs through a pear orchard, it turns the foliage black, working destruction as complete as if fire had raged among the trees. Other bacterial complaints of the olive, etc., owe their prevalence to these insects.

Now that it is understood how important a part flies play in human affairs, a new attention is being given to the study of these highly objectionable insects. They are even bred in the laboratory, for purposes of observation—an affair, by the way, of so little difficulty that anybody can easily do it for himself. It is only necessary, as a preliminary, to know how to distinguish the male fly from the female. About this, however, there is no trouble, because the head of the male is almost all eyes, while in the female there is a space between the eyes equal to one-third the diameter of the head.

Catch several flies alive, and, having picked out a male and a female, put them together under a glass tumbler, with a piece of moistened bread. From day to day add a small piece of moist bread to the heap, removing any that shows sign of mold. In a few days eggs will be observed on the heap of bread, laid in little bunches, and pretty soon these will hatch out tiny footless maggots. The maggots, feeding on the bread, will grow rapidly and some of them will crawl up and down the inside of the tumbler. At the end of a week or so they will transform themselves into "pupae," from which, two or three days later, fully developed winged flies will emerge.

These instructions relate only to the breeding of the house-fly. But flies of any other species may be similarly propagated, with the simplest means, by any one who wishes to find out the details of their life-history.

A "TOADSTOOL" TREE PARASITE.

AN EXPERIMENT IN "PEAR BLIGHT."
Inoculating the tree in same manner as if done by flies.

During recent years planters of sugar cane have suffered grievous loss from diseases which are now known to be carried by flies. One of these is the so-called "pineapple disease," which attacks the cuttings after they are planted and before they can sprout. It makes the cuttings smell agreeably, like pineapple. The same malady, curiously enough, is one of the worst enemies of the pineapple itself —particularly the variety known as "smooth cayenne," the core of which, when thus affected, turns sooty black, rendering the fruit unmarketable.

The secret of the pineapple smell is that the fungus in question produces a peculiar ether, of a delicious, cologne-like fragrance. It seems by no means impossible that it may be turned to practical and useful account commercially, for perfuming purposes. Unfortunately, however, the perfume has a very strong attraction for flies, which feed upon diseased parts of the sugar cane, and carry away the spores, scattering them wherever they go.

Flies are extremely fond of odors. Some that are horrible to us are most agreeable to them. They are attracted to the cane fields by the smell of fermenting sugar, and there feed on the sweet sap. Thus it comes about that spores of the fungi that cause all the common diseases of the cane are found in the excreta of flies caught in the cane field. The "pineapple disease" is only one of a number which they are instrumental in distributing.

Another species of cane fungus is of large size—a kind of mushroom. One of its spores, left by a fly on the cane, is washed by rain into the ground, wherein it sprouts. Its vegetation later on produces a curious fruit, which takes the shape of a whitish ball. That is to say, the ball is a sort of case, inside of which the mushroom is tightly packed, like a jack-in-the-box. At daylight the spherical box, which is beneath the surface of the earth, bursts, and within two minutes the mushroom appears above ground, attaining a height of three or four inches.

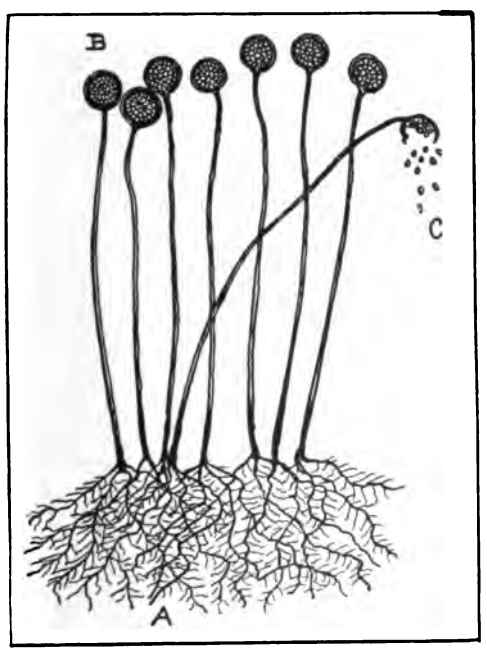
This particular fungus makes a regular business of attracting flies, in order to secure its own reproduction. It appears, therefore, at daylight—an hour when its odor "carries" best, and when the insects are hungriest. The top of it is covered with a nasty, sticky stuff, containing millions of spores, and so attractive to flies that they can hardly be driven away from the mushroom. In the ordinary course of events, they carry the spores to the sugar canes, and deposit them—to be afterwards washed by rain to the ground, to germinate, and to start the cycle over again. The vegetation of this parasite injures the tender shoots of the cane, and creeps up the stalks, the plant on which it depends for subsistence.

The familiar fruit "rots" which cause such a vast deal of damage, are spread

largely by flies. Among them are the "ripe rots" of all kinds of fruits, the "brown rot" of the peach, the "black rot" of the tomato, and many others, all of them fungus diseases, which affect the grape, the raspberry, etc. If there were no flies, comparatively little harm would be done by such troubles.

Of "rust" diseases, which attack grains and grasses, there are many. They are spread largely by flies. Typical among such maladies is the wheat rust, which, oddly enough, is originally a trouble of the barberry bush. Flies are very fond of this fungus, and eat the spores of it, when found on the under sides of the barberry leaves—afterwards carrying them to the wheat plants.

Flies, by reason of their habit of scattering fungus spores, are to a great extent responsible for the distribution of the "leaf-curl" disease of the peach; likewise for the "scab" of pear and apple, which appears in the form of dark blotches on the fruit, and for the "leaf-spot" troubles. They are common carriers of the "mildews"—such, for example, as the "powdery mildew" of the grapevine.



COMMON MOLD FUNGUS, GREATLY ENLARGED, SHOWING ITS METHOD OF GROWTH.
A—vegetation of mold fungus; B—fruit; C—ripe fruit liberating spores.

TREE CANCER IS LIKE ITS HUMAN NAMESAKE.
The disease is due to a fungous growth.

Many fungus enemies there are from whose attacks the forests suffer very seriously—such, for instance, as "cankers," which devour the bark. The spores are carried by flies. They are parasites, of course, and, deriving their sustenance from the tree, convert the living tissue of the latter into so much rot.

Even after the trees are cut down and converted into lumber, the material is liable to suffer damage from fungi that feed upon it and thus cause decay. One sometimes sees telegraph poles and fences with toadstools growing out of them. There can be no doubt that in many instances the spores of the fungi that do this sort of mischief were originally brought and deposited by flies. If a speck be suitably situated on a piece of wood, it is easy for the fungus spores it contains to introduce their vegetation into a crack, and so start a rot-producing growth.

How, it will be asked, is it possible to fight this sort of mischief? The answer is that it can be fought effectively only by the systematic prevention of fly-breeding, and by the careful destruction of all plant growths already infected, whether in forest, field, orchard, or garden. So far as fly-breeding is concerned, it can be stopped entirely in any given locality by enforcing regulations which shall prohibit the exposure of manure, the carcasses of dead animals, garbage, or other filth. Flies cannot reproduce their species unless they can find manure, decaying vegetable matter, or other nastiness, in which to lay their eggs. No filth, no flies.

Appreciation

A WASHINGTON woman has in her employ as butler a darky of a pompous and satisfied mien who not long ago permitted a chocolate-colored damsel, long his ardent admirer, to become his spouse.

On one occasion when the mistress of the house had occasion temporarily to avail herself of the services of the butler's wife, it was

observed that whenever the duties of the two brought them in conjunction the bride's eyes would shine with extraordinary devotion.

"Your wife seems wonderfully attached to you, George," casually observed the mistress of the house.

"Yes, ma'am," answered George complacently. "Ain't it jest sickenin'?"—*Harper's Magazine.*

A Bit of Conservation

AN Englishman hired an Irish cabby to get him to the train. The Irishman's horse was going very slowly and the Englishman stuck his head out of the cab-window and said:

"Whip him up. Give him the gad. Hit him in a vital spot."

"An' sure," said the cabby, "I've hit him in every vital spot but the ears, and I'm saving them for the hill."—*National Monthly.*

The Usual Thing

"DOCTOR, is it absolutely necessary to operate on me?"

"N—no. But it's customary."—*Toledo Blade.*

The Three Ages of Childhood

"How old are you, my dear?"

"Eight at home; seven and a half when I go by train, and six when I go out with mama."—*Bon Vivant.*

The Noise Was Distracting

"IS THAT you, dear?" said a young husband over the telephone. "I just called up to say that I'm afraid I won't be able to get home to dinner tonight, as I am detained at the office."

"You poor dear," answered the wife sympathetically. "I don't wonder. I don't see how you manage to get anything done at all with that orchestra playing in your office. Good-by."—*Everybody's Magazine.*

One More Unfortunate

"PSHAW!" exclaimed Miss Yerner, impatiently, "I'm sure we'll miss the opening number. We've waited a good many minutes for that mother of mine."

"Hours, I should say," Mr. Sloman retorted rather crossly.

"Ours? O George!" she cried, and laid her blushing cheek upon his shirt front.—*Catholic Standard.*

Identified

THE new housemaid had just opened the door in response to Wigglesby's ring.

"Is Miss Darborough in?" asked Wigglesby.

"Yis, sorr, she's in sorr, but she's engaged," said the maid.

"Yes, I know," smiled Wigglesby. "I'm what she's engaged to."—*Harper's Weekly.*

Anything Else?

"YOU know that pretty salesgirl I took home from the dance?"

"Yes."

"Well, I stole a kiss."

"What did she say?"

"'Will that be all?'"—*Judge.*

Her Alter Ego

MRS. F——, a Southern "social leader," was told by her husband over the telephone that he would bring a number of guests home to dinner. The party was altogether unexpected, and there was not enough food in the house to supply the table.

Mrs. F—— at once instructed her cook to order certain supplies while she planned the rest of the dinner. A little later she was horrified to hear the cook talking ferociously into the telephone, as follows:

"An' Ah want six dozen sof'-shell crabs, and ef yo' doan' get dem up here mighty quick Ah'll skin every one of yo', ye' low down—'Who is dis?' Dis is Mrs. F——, dat's who dis is, and Ah means ebery word Ah say."

"Mandy," cried the mistress, "what do you mean? You must not use such language!"

"Lawsy," returned the cook, "that's all right, Mis' F——. Ah talks to 'um like dat for yo' all de time."—*Harper's Weekly.*

The Right Place

AN anxious father got wind of the rumor that his son was leading a convivial life at college. But the son strenuously denied the

charge in letters to his father. Still unsatisfied, the father made an unexpected visit to his son's lodging place and, giving the bell a manly pull, was met by a grim-faced landlady.

"Does Mr. J—— live here?" asked the father.

"He does," replied the landlady. "Bring him right in."—*Harper's Weekly.*

Health Note

A MEDICAL paper claims that a dentist's fingers carry disease germs. Moral: Boil your dentist.—*Boston Transcript.*

Oh, Lovely Woman

"WOMAN is very unreasonable," said a venerable New Hampshire justice of the peace. "I remember that my wife and I were talking over our affairs one day, and we agreed that it had come to the point where we must both economize.

"'Yes, my dear,' I said to my wife, 'we must both economize, both!'

"'Very well, Henry,' she said, with a tired air of submission, 'you shave yourself, and I'll cut your hair.'"—*Everybody's Magazine.*

Pure Thought

A lady summering in Maine said to her milkman severely:

"See here, this milk of yours is half water and half chalk. What do you mean by advertising it as pure?"

"Madam," said the milk manufacturer with withering dignity, "to the pure all things are pure."—*Everybody's Magazine.*

What To Say

(To be written by a Young Man on Receipt of a Letter from the Father of an aged Spinster with Peroxide Hair and Few Hopes, asking his Intentions.)

Colonel Willoughby Higgins:

DEAR SIR—Your letter of the 10th instant to my brother James asking his intentions in respect to your daughter has just come to hand. My brother has just started on a five-year walking-trip through Tibet, but I will bring the matter to his attention immediately upon his return.

Very truly yours,
GEORGE W. JIMPSON.
—*Harper's Weekly.*

Very Likely

THE case concerned a will, and an Irishman was a witness. "Was the deceased," asked the lawyer, "in the habit of talking to himself when alone?"

"I don't know," was the reply.

"Come, come, you don't know, and yet you pretend that you were intimately acquainted with him?"

"The fact is," said Pat dryly, "I never happened to be with him when he was alone."—*Pittsburg Observer.*

WOMAN ENGINEER RUNS PIPE LINE

By HARRY H. DUNN

IN Los Angeles, California, there is a woman, a little woman, too, who has broken into an entirely new profession for women—civil engineering.

Behind transit and level she has run a Standard Oil pipe line, and done the work so well that the great tube is one of the most successful petroleum carriers on the Pacific Slope. With her own hands she carved out a life-sized piece of marble statuary, which was one of the few art works rescued from the San Francisco disaster of April 18, 1906. At Whittier, where she ran the pipe line, she also laid out the large high school grounds.

She recently turned down an offer to survey a line through Mount Shasta, in order to take a vacation in Honolulu.

Miss Lena R. Haas, C. E., is the way she signs her name, and when, after graduating with honors from the art course at the University of California, she signed her name "L. R. Haas," to a telegram asking entrance to the civil engineering course of staid old Columbia, of course the faculty thought her a man, and she was told to come on.

When she arrived in New York, however, instead of the burly Western surveyor the professors expected, there stood a slender girl, who properly belonged, not in Columbia, but in Barnard College, the young women's annex across the street.

MISS LENA R. HAAS, CIVIL ENGINEER.

Probably the wise men of Gotham thought when they let down the doors that the work would be so difficult that Miss Haas would soon be willing to quit, but she did not quit, though she was one woman in a class of one hundred and fifty men.

After completing courses in the Los Angeles High School, the State Normal School, the State University at Berkeley, Mark Hopkins Institute and Columbia University, Miss Haas coined a new word, "mechanigraphics," and then settled down to teach the science for which she had created a name. At present she is handing it in homeopathic doses to a large class of boys in Los Angeles Schools.

POPULAR · SCIENCE & MECHANICS SUPPLEMENT ·

BIRDS MADE TO ORDER

LAWS forbidding trade in the skins and plumage of wild birds, backed by growth of a strong popular sentiment in this regard, have built up a very important new industry — namely, the manufacture of artificial birds out of feathers obtained from the farmyard. Many of them are extremely artistic, and even beautiful. What, for example, could be more clever than these owls' heads, which are made out of the body feathers of chickens, with celluloid beaks and black buttons for eyes?

They remind one of the animals that children make of peanuts or potatoes and seem little less like toys. But they save real birds' lives.

FOUR-LEGGED CHICKEN. This photograph comes from Germany where the chicken, whose portrait this is, actually was hatched and lived recently.

DYED HEN LAYS EASTER EGGS

A WHITE hen has been persuaded, after a course in dietetics with professors of the Cornell State College of Agriculture, to lay eggs bright with the Cornell colors. The yolks are red and the albumen white. A harmless dye was given to the hen with her feed, and when it was seen that her plumage began to turn a delicate pink, her eggs were examined and found to be still more deeply colored. Other admixtures of dye turned the yolk of the egg pink and the hen's feet pink. The hen and her product were on exhibition at Cornell and caused much comment, but the system is not yet commercially practicable.

PARIS UNDER WATER

THE recent floods in the city of Paris about which full accounts have appeared in the newspapers all over the world, furnished some very interesting and novel experiences for Parisians and for visitors in the beautiful French city. The pictures reproduced on this page show some of the unusual scenes that were witnessed during the time when a large portion of Paris was under water. Streets where foot passengers must cross were made passable by means of planks laid on sawhorses some three or four feet above the surface of the water. All sorts of odd craft were devised of which the double tub, in the center of this page, is one odd example. Many a strong-backed man made himself useful and incidentally profited considerably, by carrying people to and fro upon his shoulders. The gendarmes were the busiest people in the city and they served a good purpose in aiding to transport both persons and supplies of the citizens, where it would have been difficult to have done without them. The manner in which supplies were delivered at many houses in the flooded district is shown in one of the pictures printed herewith. Boats were sent up and down the streets loaded with supplies and people received them in their second story windows which were reached by means of ladders set up in the water.

DELIVERING SUPPLIES.
Women did their buying from their second-floor windows and goods were delivered by boat and ladder.

RISKY WALKING.
Footbridges made of planks on horses for street-crossings.

NOVELTY IN A BOAT.
This is only one of the odd devices that made their appearance.

THE BUSY GENDARME.
Soldiers had their hands full in helping the people get about.

ONE WAY OF MAKING HAY.
It was not exactly sunshine that brought this man a considerable profit.

The river Seine was a raging torrent and spread its waters far and wide over a very large section of the city but it is said that the gaiety of the people, was if anything, enhanced by the difficulties under which they pursued their pleasures. A little spice of danger and risk seemed to add to their enjoyment of their pursuits.

WHICH SIDE UP?
A test, by turning this page upside down, will show you that it is hard to tell which is the reflection in the oil pool in this picture.

IN MEMORY OF BLÉRIOT'S FEAT.
This odd memorial of stone, is placed at Dover, where the Frenchman's airship landed after the first flight across the English Channel.

WASP-WAISTED TREE-TRUNK

SOMETHING over a year ago a great trunk was set up in the beaver's lair at the London "Zoo" for the purpose of giving him something to sharpen his teeth on. The persevering rodent put in many hours a day at the task, with the result which is shown in the photograph. The wasp-waist holds, though the top of the trunk sways in a wind, and the wily beaver refrains from giving the last bite which would bring it crashing on his head. How long it will hold against wet and rain is a matter of guesswork, but the beaver will not be caught when it falls for he is watchful.

A BUSY BEAVER'S WORK.
Rodent kept his teeth sharp here, but was careful not to gnaw through.

NINETY HORSEPOWER DRAGON

ONE of the greatest features of the Chinatown festivities in San Francisco was the huge dragon made of silk and tinsel which was carried in the street parade. Heretofore it has been borne on the shoulders of a score or more of Celestials, but at last the spirit of the age has seized even the conservative Chinese. In the parade of last New Year's eve the huge monster was mounted on three automobiles, coupled closely together. The gorgeous dragon was supported on racks placed upon the automobiles which had to be driven with extreme care on account of the hilly San Francisco streets.

NINETY HORSE-POWER DRAGON.
A chinese concoction mounted on three big motor-cars at a recent parade in the city of San Francisco.

AN ALL-STEEL TRAIN.
This is the type of the trains now being put on by several great roads. This is a Pennsylvania train in which all cars are entirely built of steel.

NEW YEAR'S CUSTOMS

PROGRESS is the watchword of our age in every conceivable line. Even the pleasures seem to be getting gayer and more exciting which can plainly be seen on New Year's Eve when all who are able, hurry to the heart of a city with horns and various other instruments for making noise, joining the general hubbub. In nearly all great cities at midnight the church bells and the whistles from ships in the harbor mingle with the glad shouts of "Happy New Year." Quite a novelty was seen this year in the streets of Philadelphia, "The Giant on Stilts," shown in our picture, who proved to be a new attraction and had a gay following of merry makers.

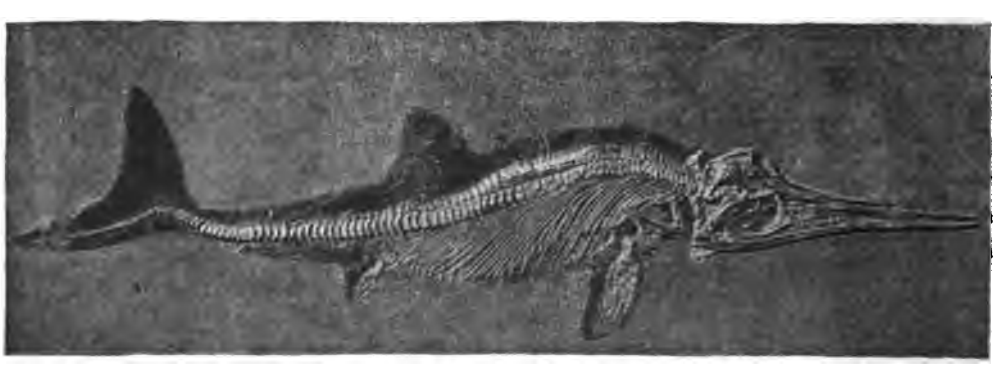
NOVELTY IN FANCY COSTUME.
Berliner's clever idea for parade expertly handled.

NEW ICHTHYOSAURUS

THE gallery of Paleontology of the great Jardin des Plantes Museum of Paris, has recently acquired a most remarkable specimen of the Ichthyosaurus, an antediluvian animal, half fish, half crocodile, which lived several hundred thousand years ago in the period which geologists designate as the secondary era. At this epoch reptiles were the masters of the world.

Central Europe was then under water and it is on the shores which have emerged from these secondary seas in the shists and marls that are found the specimens which ornament the collections of Paleontology.

Among the creatures that have disappeared the fossil with which we are occupied is the best known. It represents the perfect type of carnivorous swimming animals. Its teeth number ninety on each side and organic remains are found in its stomach. The limbs form remarkable organs for propulsion and swimming. The eyes are optic instruments of varied and prodigious power



GIANT ICHTHYOSAURUS OF PARIS MUSEUM.
Valuable relic of the secondary era when reptiles were rulers of the world.

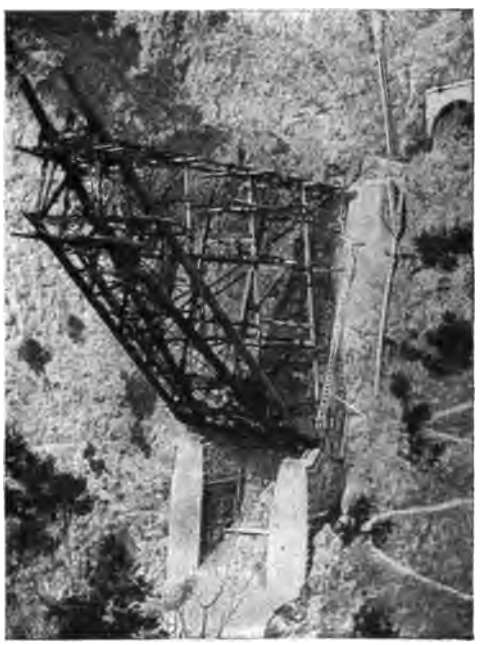
INTERESTING TRESTLE BRIDGE.
Structure recently built at Cleveland, Ohio, in which the material is mainly wood, is a novelty in this day of steel.

NEW THERMOPYLAE VIADUCT

A RAILROAD has recently been built which connects Athens, the capital of Greece, with the Ottoman frontier, a line which, when extended as far as Salonique, will place Athens in direct communication with the railroad systems of Europe.

The new railroad traverses a region of an extremely varied aspect, and necessitated the construction of numerous remarkable bridges, tunnels and viaducts. Among the latter the most interesting is the viaduct which crosses the Gulf of Assopos, between Lianokladi and Dadi not far from the celebrated defile of Thermopylae.

This viaduct is interesting not only because of the harmony of the design, but particularly, for the manner of mounting employed by the Societe de Batignolles, which had charge of its construction. It was necessary to cross the gulf with one single span, no intermediary support being possible in this place.

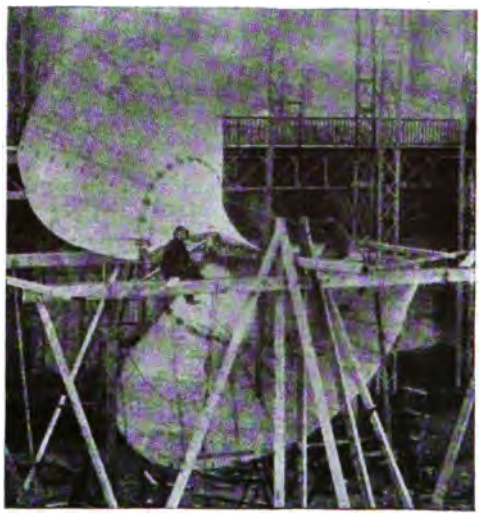


AN END OF THE THERMOPYLAE BRIDGE.

This unique roadway has a total length of 587 feet between the abutments. Above the gulf it is composed of a metallic arched truss with 264 feet of space between the articulations of the spandrel and has a rise of 76 feet.

The building of this structure was accomplished in thirteen months. It is a beautiful piece of bridge-work and is attracting wide attention among engineers, all the world over. A very good idea of the principal span is given in the print.

NEW THERMOPYLAE VIADUCT.
Remarkable span on a Greek railroad not far from the famous defile where Greeks and Persians fought.



A REMARKABLE AIR-BEATER.
To be placed in front of a dirigible air-ship to break up a head wind.

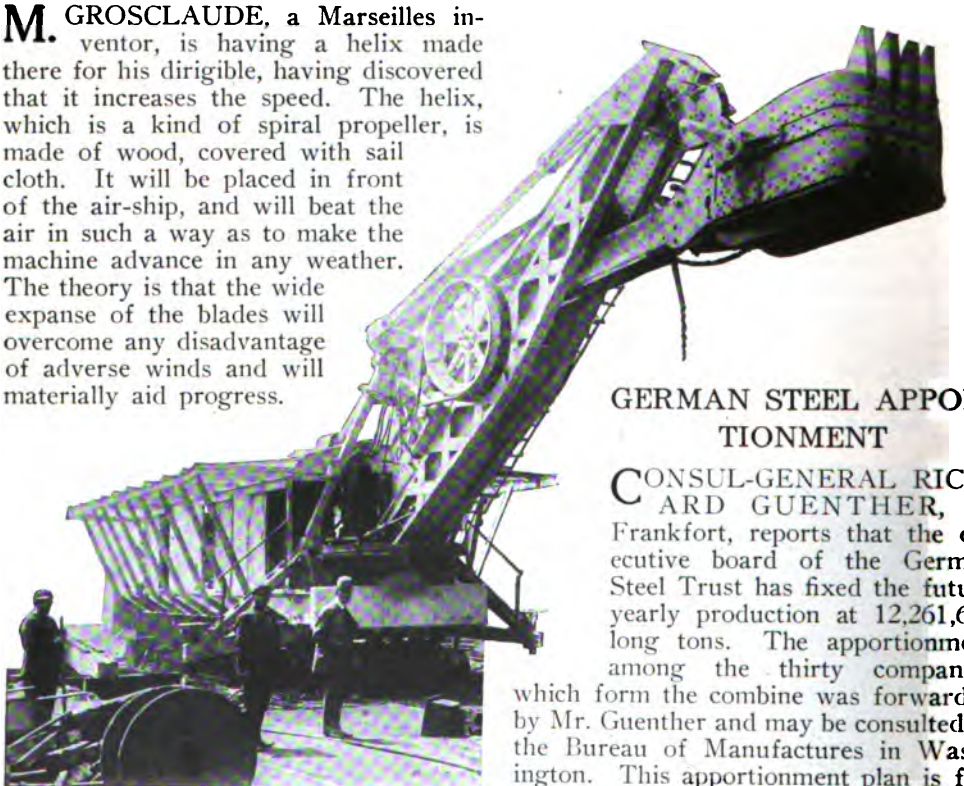
BEATING THE AIR

M. GROSCLAUDE, a Marseilles inventor, is having a helix made there for his dirigible, having discovered that it increases the speed. The helix, which is a kind of spiral propeller, is made of wood, covered with sail cloth. It will be placed in front of the air-ship, and will beat the air in such a way as to make the machine advance in any weather. The theory is that the wide expanse of the blades will overcome any disadvantage of adverse winds and will materially aid progress.

ELECTRIC-SHOVEL

THE Brooklyn Edison Company is making a new departure in the methods of subway and tunnel construction by the introduction of electric shovels in place of the old style steam shovels for excavation and digging purposes in connection with the new work on the South Brooklyn subway which is now well under construction. The electric instrument is more easily controlled, is practically as capable, requires no frequent trips to the car barns for fuel and is more economical. Perhaps the chief advantage is that it makes no noise and hence the complaints against the company when the steam-shovels were used have been discontinued with the introduction of the electric excavator.

It may be said that, as far as power is concerned, the new shovel is the equal of the steam-shovel in all respects, while the advantage of ready control is inestimable.



HUGE ELECTRIC SHOVEL.
Latest department in which electricity is displacing steam. Owned by Brooklyn Edison Co.

GERMAN STEEL APPORTIONMENT

CONSUL-GENERAL RICHARD GUENTHER, of Frankfort, reports that the executive board of the German Steel Trust has fixed the future yearly production at 12,261,617 long tons. The apportionment among the thirty companies which form the combine was forwarded by Mr. Guenther and may be consulted at the Bureau of Manufactures in Washington. This apportionment plan is followed regularly in Germany. The total production in the United States is about twice as great.

STRUCTURE IN THE HEART

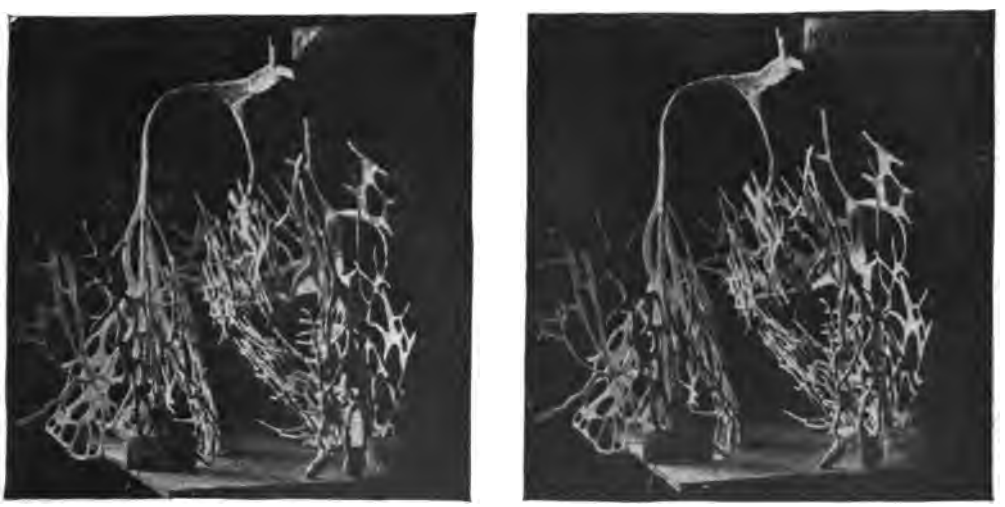
SOME irregularities of the heart beat in certain forms of heart disease have received an explanation. The heart contains a mechanism which has only recently been discovered. It is a branching tree-like structure which ramifies through the walls and makes a connecting link between the auricles and ventricles. Look at the accompanying views through a stereoscope and you will have a good idea of what a wax model of this much branching organ looks like. It is contained in a cavity of the same shape, filled with a lubricating fluid, except the fine terminal twigs, which mingle with the heart muscle. The tree-like organ is proved to be a conducting path for the stimulus which excites the successive portions of the heart to beat. When the main connecting link between the auricles and ventricles is cramped in the mammalian heart, an irregularity in the beat of the ventricle is caused. In such cases the ventricle beats slower than the auricles. When the compression is removed the ventricle begins again to beat with the same regular auricular rhythm as before.

EXTRAORDINARY HYDROPLANE.
English experimental boat with air-propeller and automobile body.

TARGET PERFORATED BY 12-INCH SHELLS.
Eleven hits were made by an English warship in one minute at 8,000 yards.

CLEVER SHOOTING

THIS picture shows a target recently used by an English warship in gun-practice. Eleven hits were made with twelve-inch shells in one minute at 8,000 yards.



STEREOSCOPE PHOTOGRAPH OF MODEL OF HEART'S STRUCTURE.
Curious mechanism recently discovered that makes connecting link between auricles and ventricles.

PAPER FROM BAGASSE

THE manufacture of paper from bagasse, the dry refuse of sugar cane after the juice has been expressed, has often been advocated, but never accomplished on a commercial scale. The increased cost of wood pulp has stimulated experiments for solving this problem. It has long been known that excellent paper can be made from sugar-cane fiber, but the difficulty has been to preserve the fiber intact while extracting the juice for sugar making. The present machinery cuts and tears the fiber so that the bagasse is fit only for fuel.

A company organized in the United States is constructing a large plant at Preston, on Nipe Bay, to make a practical test of a patented process for expressing the juice and conserving the fiber and pulp for paper. The fiber is separated from the pulp by machinery, and then by evaporation the water is eliminated, leaving the dry fiber and pulp containing the solids and sucrose, from which sugar is made. The fiber and pulp are then baled separately for shipment to the United States, where the sugar is extracted by diffusion.

By this treatment the fiber is uninjured and can be used in making high-grade paper at a considerable saving as compared with the cost of wood pulp. The residue from the pulp is also suitable for low-grade paper. It is claimed that the preliminary tests, on a small scale, have proved successful, and that in addition to preserving the bagasse for paper manufacture, a larger percentage of sucrose is obtained than is possible by the present methods of extraction in sugar houses.

SPARROW CATCHING AT NIGHT.
The birds at roost in vine or hedge are easily caught by laying a net over them and allowing them to fly into it. An English method.

LOCOMOTIVE FOR THE COLOMBIAN NATIONAL RAILROAD.
One of the Mallet articulated type for the new southern route.

INDIAN TEA-TASTER AT WORK.
An expert will often taste as many as 1,000 samples in one day.

TEA-TASTING

THE grading of teas for market is accomplished by tasting. It cannot be done in any other way. To do it well is extremely difficult. Very few men have the delicacy of taste requisite for the purpose, and they are able to command big salaries. An expert tea-taster will often taste as many as 1,000 samples of tea in a day. He does not swallow it usually. To drink much tea would render his taste less acute, and his judgment proportionately less accurate. Nevertheless, the professional tea-taster is liable to suffer from headache, giddiness, and other disagreeable symptoms. It is claimed that the occupation tends to shorten life, and some of the insurance companies will not insure tea-tasters. But on this point they differ in opinion.

SHELTERED FOUR MEN FOR SIX MONTHS.
Pioneer shown in this photograph was one of the tree's occupants.

A TREE-HOUSE

BY the ravages of dry-rot and fire, the giant firs and cedars of the Pacific Northwest are frequently hollowed out and left standing like huge chimneys.

Probably the most elaborate is the one located in Snohomish County, Washington, which consists of a huge cedar stump sawed off about ten feet from the ground, roofed over with shingles, and fitted with floor, door and windows. A family lived in this shelter for some time. In Jefferson County a big burned-out cedar was used as a camp for over six months by a party of four men who were engaged in clearing land and building farm-houses. The pioneer, shown in the illustration of the big stump, was one of the original party who were thus sheltered over thirty years ago in this great tree.

FORTRESS ON WHEELS.
English inventor's idea of an automobile made useful for war.

MAKING A BEAUTY SPOT

THIS isn't as you might suppose, a scene from Italy, but merely an example of how an American city converted its ugliest feature into a beauty spot, the admiration of a million travelers a year who pass through Kansas City's Union Depot. For years and years the depot faced a rock bluff, two hundred feet high, upon the face of which were perched an unsightly aggregation of negro shacks and billboards. Then the city condemned the whole face of the bluff, cleared off the shacks and billboards, built the parapet and stairway with a boulevard half way up, planted ornamental shrubs and made of it a show place, and a standing advertisement of its progressiveness.

INDIAN BASKET FOR CORN.
Woven container used in our great Southwest for storing acorns and grains

BIRD SKELETON WORTH $600

ONE of the valuable bird skeletons of the world belongs to the Smithsonian Institution, but was originally the property of a Great Auk—the bird which, exceedingly numerous a century ago in the North Atlantic region, is now extinct. The principal breeding place of this interesting fowl was Funk Island—an isolated rock thirty-two miles off the coast of Newfoundland. There it was formerly to be found in countless numbers, and, being very fat and good to eat, was ruthlessly slaughtered. Whalers victualled their ships with auks; feather-hunters destroyed them by thousands for their plumes, and it was said that they were even "tried out" for oil. Their extermination was inevitable. Not long ago the Smithsonian Institution sent an expedition to Funk Island, to

KANSAS CITY'S BEAUTY SPOT.
The bluff where this handsome structure now stands was an ugly feature of which the city was ashamed.

COLONY OF FRUITBATS.
A pest of California that offers a curiously picturesque appearance.

get some bones of the Great Auk—the only memorials of the bird remaining. Great numbers of these were dug up, but it was possible to obtain a complete skeleton only by putting together parts of many individuals. Thus the specimen whose osseous framework is herewith shown is in reality a composite. It is valued at $600.

A MOTOR-GONDOLA.
Italian craft fitted with a motor is a novelty soon to be seen in American waters.

GREAT ENGLISH DAM

IT is now ten years since the Derwent Valley Water Board was constituted to acquire rights over the head waters of the river Derwent and its tributaries. It was claimed that, rightly apportioned, there was water enough for each of the rival authorities of various towns to last for forty years.

The works authorized are on a gigantic scale. There will be five reservoirs and a service reservoir, about one hundred miles of aqueduct, and twenty acres of filter-beds. Broadly speaking their capacity will be ten billion gallons, and they will receive the rainfall from 31,694 acres. The total cost of the scheme is estimated at $30,000,000. A model village christened "Tin Town," with elaborate provisions for workmen, has sprung into existence at Birchinlee. Two of the reservoirs are drawing near to completion—the Howden and the Derwent.

The total collectable yield of the watershed is estimated at 50,000,000 gallons per day. The works are being constructed in installments so that they may soon yield a daily supply. The section from the Howden and Derwent reservoirs is expected to give 13,000,000 gallons daily that can be used in the near future.

SKELETON OF A GREAT AUK.
Valuable relic in possession of the Smithsonian Institute.

WING TRENCH FOR BIG DAM.
Part of work necessitated by unforeseen obstacles on the great English undertaking.

REMARKABLE BRITISH DAM.
The structure will impound 1,900,000,000 gallons of water in the valley at the right.

ELECTRIC CLIPPER.
Useful device that makes horse-clipping easy.

BRIDGE FOR AUTOMOBILES ONLY

THE accompanying illustration shows one of five automobile trestle bridges built on the farm of John W. Freeman, south of Joplin, Mo. While a horse would find it impossible to traverse the frail looking structure, a motor car is safe in whizzing over the viaduct at considerable speed, the grooves in which the automobile wheels fit being so constructed that Mr. Freeman declares it impossible for them to jump, and to prove his assertion he has sped at a breakneck pace over the tramway.

The bridge shown in the picture is 525 feet long, is thirty-four feet high at its greatest elevation and is composed of uprights, six by six inches, braced with two by eights and two by sixes. Running the length of the tramway are troughs or grooves eight inches wide, five inches deep and fifty-six inches apart just wide enough to accommodate the wheels of an automobile. The bridges are located over valleys for a distance of more than half a mile and the necessity of reaching the farmhouse by a long, winding country road is done away with. At the entrances to the viaducts the troughs widen to permit the wheels being guided into place. In places tree trunks are used for supports.

ELECTRIC CLIPPER.
Motor hangs from ceiling and swings free for all movements.

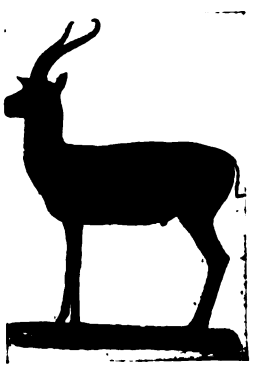
BIG CASTING OF STEEL.
Unusual single piece for tunnel work. Size may be judged by comparison with the group of men who helped make it.

VIADUCT FOR AUTOS ONLY.
Joplin, Missouri, man's interesting bridge across a valley in his farm.

NEW METHODS OF MOUNTING.
Gazelle manikin prepared of clay. Horns are retained, leg bones discarded.

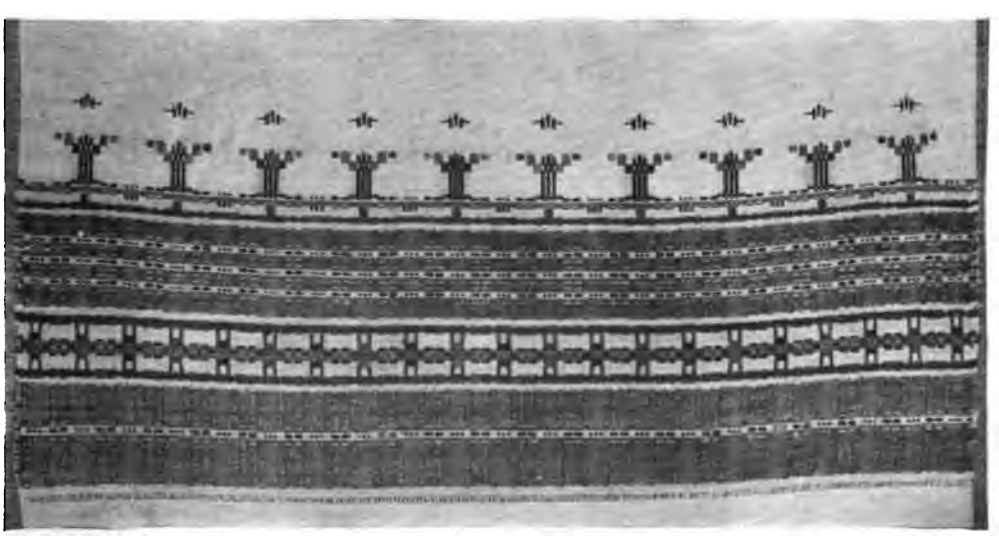
BLIND WEAVERS

BLIND designer? Impossible, one would say, until they had seen the handiwork of pupils of the Cambridge Art Fabric Shop, where blind girls and some men are working under the direction of the Massachusetts Commission for the Blind. Skeptical as one may be, however, it is a fact that the motifs designed by the totally or partially blind women at this place are truly remarkable, showing not only a comprehension of the principles of design as gathered from their instructors, but great originality as well. The looms at the Cambridge shop are modeled after those of our grandmothers, only smaller in size. The plain weaving or body of the goods is made very simply. By depressing certain pedals every other thread of the warp is lifted and the shuttle is thrown through by hand with no more difficulty for the blind than for the seeing. To reproduce a design another set of pedals is depressed and the warp threads are raised in definitely distinguishable groups, as characteristic to touch as to sight. A blind weaver can find any one of the threads in this group and so the making of a pattern is rendered comparatively easy.



NEW METHODS OF MOUNTING.
Skin of gazelle placed over clay manikin gives remarkably life-like effect.

UNUSUAL PHOTOGRAPH.
A wounded and ugly chicken-hawk, snapped by Mrs C. E. Hatcher, of Crown King, Arizona.



DESIGN MADE BY A BLIND GIRL.
Woven center-piece wholly planned and executed by a sightless young woman of Boston.

PECULIAR BULLETS

ALTHOUGH lead is generally considered the only material for bullets, other softer and lighter substances produce quite effective results. Water bullets are often very destructive if shot with great speed. They are made of a piece of cartridge shell about one and one-fourth inches long, which is filled with water and closed on both ends by means of fat-plugs. One of our pictures shows a board one and three-sixteenths inches in thickness, which was penetrated by such a water bullet, shot against it from a distance of four inches with an ordinary powder charge behind it. Greased felt plugs, which are shot from a distance of seven feet against wooden boards, make an impression of up to five thirty-seconds of an inch in depth, and a stearin candle of six inches in length will even penetrate two pine boards each one and one-fourth inches thick which are placed one behind the other. Wooden plugs of one and one-half inches in length, will cause an impression three-fourths of an inch deep if shot against boards, and if aimed against three hard-lead plates, each one-eighth of an inch in thickness, which are placed one behind the other, will penetrate two of them and damage the third, even if striking sideways, as shown in our picture.

HOLE MADE BY FELT.
A greased felt bullet made a hole in this board ⅛ of an inch deep.

PENETRATED BY WATER-BULLET.

THREE LEAD PLATES.
These were penetrated by a wooden bullet fired from a gun.

FOOTPRINT ROCK.
Remarkable stone that is foot shaped and bears imprints of human feet; found in Seminole Mountains in Wyoming

SILK SPUN BY A NEW WORM

A NEW kind of silk-producing caterpillar is about to be introduced to the world. In Assam, where the natives call it "eri," it has been used for silk-spinning for centuries; but, strange to say, its employment for the purpose has been restricted almost exclusively to that region. The British government in India, however, is taking steps to extend the utilization of this caterpillar, with a view to producing its silk on a large scale. One of its advantages is that its cocoons are not sealed, like those of the common silkworm. The larva leaves one end of its cocoon closed only with converging loops of silk. This renders it unnecessary to kill the insect when its silk is used.

NEW KIND OF SILKWORMS.
Rearing-tray for species that does not seal its cocoons.

SPEAKING IRON

AN ODD RECEIVER.
New German device makes phone message generally audible.

AN instrument that has aroused considerable interest recently in New York is the concertophone. The audience in all parts of a great building heard the music of the latest opera transmitted by telephone from a theater many blocks away. The complex apparatus required makes the concertophone quite expensive, but recent experiments in Germany have brought to light a new and very simple arrangement by which sounds transmitted by telephone are reproduced loudly enough to be heard in all parts of a hall. It is practically the ordinary telephone in every respect except that a different receiver is used.

NEW MAST LIGHT.
Electric device for steamers protected by wire guard.

The receiver is shown in one of the photographs. It is merely an upright, round bar of soft iron with two coils of wire around it. The lower coil is of comparatively heavy wire and is connected to a generator. The upper coil is connected to the telephone circuit. Between these two coils is an iron disc about a quarter of an inch in thickness. Words spoken in the distant transmitter are reproduced by the new receiver very loudly and with marvelous distinctness.

RECEIVER COIL.
It is simply made with upright of soft iron with two coils around it.

The inventor of this apparatus has also designed a telephone receiver which is much simpler and much more easily made than the ordinary receiver. It consists merely of a coil of wire wound either loose or on a bobbin. The sounds reproduced by this receiver are of remarkable clearness and purity.

The tones can be made louder by placing a disc against the coil. The simplicity and cheapness of this instrument will probably bring it into very widespread use.

Practical advantages of the instruments first described lie in the cheapness with which they can be supplied. The apparatus is very desirable for many purposes and will be in considerable demand, if it is demonstrated to be entirely practicable. Those who have witnessed its use have much to say in its favor.

LOOKING DOWN ON ST. LOUIS.
This is not Chicago's view of the handsome southern city, but a view from a balloon.

GIVING BIRDS A BATH.
Successful device that tempted feathered visitors.

GIVE THE BIRDS A BATH

IF you wish to attract the birds, give them a bath, and this is the way it may be done. One bird lover took a discarded bee hive "super" for a frame. This is simply a frame of seven-eighths inch boards four and one-half inches wide and fourteen by twenty inches square outside. For the water "pan" the skin of an old canvas canoe, folded so as to sag and give a depth of water from nothing at one end to four inches at the deepest part was used. The canvas was securely tacked to the edges of the frame and trimmed off flush. This season a dog attempted to use it and put his feet through it, so the owner has had the tinsmith make a pan of galvanized iron. It is made to rest on the top of the frame and runs from nothing at one end to four inches at the other, thus giving a depth for large or small birds. The iron pan is handier than the canvas though the birds do not seem to like it so well. A ten quart watering pot fills it to the brim, and it is so popular that on hot days it is often necessary to fill it twice. The birds seem to enjoy splashing and preening here and it is a delight to watch them at their ablutions.

ONE-PIECE AUSTRIAN RUG.
A prize rug that contains 7,344,000 knots. Its size can be judged by comparison with the people at its farther edge.

A MONORAIL WAGON.
Belgian invention which runs on the wheels under the car and is balanced by those at the sides. High speed is claimed for it.

UNIQUE RAILWAY TRESTLE

AN interesting piece of bridge and trestle work has just been completed on the line of the Lake Erie & Pittsburg Railroad, near Cleveland, Ohio. The structure spans the valley of Tinker's Creek, which is nearly half a mile wide at this point, seven miles south of the south boundary of the city. It will give the Lake Shore & Michigan Southern an entrance into Pittsburg.

Tinker's Creek is formed by the flow from a high water-shed to the eastward of and more or less parallel to the Cuyahoga River. The valley parallels this river for a considerable distance through Cuyahoga and Summit counties and rapidly widens out from the point where the Pennsylvania Railroad crosses it, near Bedford. The valley has been formed by centuries of cutting through shale strata, which affords an excellent foundation for the railway structure when the surface material has been removed below the frost line. The crossing consists of a steel viaduct at the north end, 1,280 feet in length and 170 feet high, and a timber trestle at the south end, 1,150 feet long and sixty feet in height.

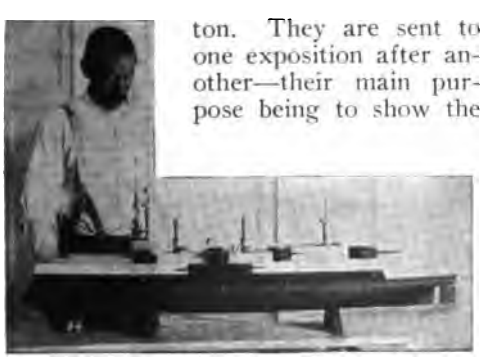
REMARKABLE NEW BRIDGE.
One span of the Lake Erie and Pittsburg structure near Cleveland that is 2,430 feet long.

BUILDING TOY BATTLESHIPS

THE construction of the new Dreadnaughts for the U. S. Navy has rendered necessary the making of models to represent them. For every class of war vessels in the service there must be one in miniature for exhibition purposes. Usually they are executed on a scale of a quarter of an inch to the foot. To all intents and purposes, they are toys. But they are very remarkable toys, and some of them have cost as much as $8,000 apiece. These toy battleships and cruisers are built by the Navy Department from the original plans of the full-sized vessels, furnished for the purpose by the Bureau of Construction. They are in all important respects exactly like the big ships, the smallest fittings and equipments of which are carefully reproduced. Even the big rifled guns and small rapid-fire guns are faithfully copied. Three or four men are kept at work all the year around making these little warships, some of which are always on exhibition at the War Department in Washington. They are sent to one exposition after another—their main purpose being to show the American people, a great majority of whom never see a real fighting vessel, what the ships of the United States Navy are really like.

A VAMPIRE BAT.
This is the bat that has well-known blood-sucking propensities and is a nuisance to cattle-men.

BIG LAKE FREIGHTER.
Type of boat that carries the Lakes' huge burden of traffic.

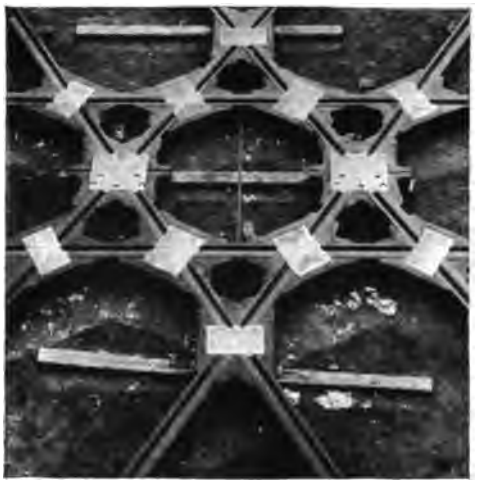


A NAVAL TOY-MAKER.
The man and one of his toy battleships after which big boats are planned.

HOME-MADE MOTOR.
Boston young man made duplicate of New York Central locomotive from household materials.

HOME MADE MOTOR

A MODEL electric locomotive made by Nathan Lord of Boston, Mass., won the first prize for amateur electric construction at the Boston Electric Show. The locomotive is a facsimile of a New York Central locomotive and was built by the constructor with nothing more encouraging to help him than a picture cut out of a technical periodical. Mr. Lord is a high-school student and has never seen an actual electric locomotive or studied electricity. He had the idea to build an electric locomotive some two years ago and with the clipping, which gave him an idea of the exterior appearance of the real thing, he set to work and devoted the whole of his spare time for the following two years in its construction and completed it in time for the electric show. One of the remarkable things about the model is that it is made of ordinary household materials.



TRIPLE-TRACK CROSSING.

DIFFICULT TRACK-CROSSING

IN the installation of some new car tracks in New Jersey, it was found that three tracks would have to cross at the same place, and the order for the crossing was placed with Hoboken manufacturers. The resulting crossing in the photograph shows how the issue was successfully met. The crossing is of the regulation hard center type, in which the lighter portions are made of very hard metal to keep the points in alignment. When finished it presented the symmetrical lines shown in the photograph, quite similar to snow crystals.

A FOUNTAIN IN A TUNNEL FROZEN BY INTRODUCTION OF COLD AIR.

NEW TRANSFER TABLE

AN eastern street railway has adopted electric transfer tables for cars instead of having the usual maze of switches and frogs leading into their car-barns. Laid at right angles to the tracks that run into the yards and placed on a movable transfer platform are two rails of standard gauge on which the car to be switched is run. The transfer table is then run along until opposite the desired track when the car is pulled off and run into the barns.

NO MORE HAND LABOR.
Turning a car by electric power.

FREEZING AS A HELP

WHEN building deep shafts through soft and moist ground, the mining engineer very often is confronted by difficulties that up to a recent date seemed to be unsurmountable. For instance, water often spurts from the ground, and it has happened that water flowed from the walls of the shaft in such quantities that it could no longer be controlled by powerful pumps. A very novel method has been discovered which enables the mining engineer to continue and complete work. The ground through which the shaft is to pass is frozen solid, which makes the work much easier, doing away with the danger. The freezing is accomplished by means of cold air pumped through tubes into the shaft, or by the circulation of very cold solutions.

LEAST-KNOWN ANIMAL

THERE is now in the National Zoological Park at Washington, a lophiomys, the first of its kind ever photographed, ever captured, ever seen by civilized man. It recently arrived in America with the consignment of live animals sent home from Africa by the Roosevelt-Smithsonian expedition. It is the point of interest about which is centered more of gossip in biological circles than any creature that has appeared for many years.

When the Roosevelt party was at Nairobi, where is located the ranch of W. N. McMillan, the American, a party of Winderobo hunters came into camp with the lophiomys in a gunny sack. Now that the lophiomys is lodged in the National Zoo, in the midst of many scientific men, a controversy is being brewed as to its classification and antecedents. To the layman at first glance it looks like a member of the porcupine family. But its spines are not stiff. Its stripes and size suggest the skunk, but it is odorless. Its head is rat-like but it is as big as a cat. It climbs trees like a squirrel but sleeps by day and is carnivorous. It is a mystery and a novelty. None of the great zoos of Europe have ever seen its kind.

LEAST KNOWN ANIMAL IN THE WORLD.
The lophiomys, first specimen of his kind ever captured. A Roosevelt live trophy.

It is really considered a remarkable find and is attracting not only the attention of the general public but that of many scientists.

FIFTEEN THOUSAND ACRES OF LIMA BEANS—A REMARKABLE WESTERN CROP AT THE HEIGHT OF THE SEASON.

PERPETUAL ADVERTISER.
A wheel that pretends to perpetual motion and attracts much attention.

A PERPETUAL ADVERTISER

THIS twenty foot wheel revolves all day and all night, for it is a bona fide perpetual motion machine, so it is claimed. With true American resourcefulness the inventor has made it earn money as an advertisement, while it is being demonstrated. The theory is that of leverage, the wooden wheel is pulled down on the left rim by heavy metal balls at the circumference, while by the curving grooves that radiate from the axle, the balls at the right gradually slide to the center, whence as the wheel revolves they slide once more to the left rim. The motion is continuous but slow and weak so that as yet no power can be produced, but as it is said to be the first perpetual machine that was ever made to keep going it is worth serious consideration. It is patented, allowed and pending, by H. E. Miller of Los Angeles, and stands over a side street in the business section of that city.

Doubters claim that the wheel is run by a hidden motor and that the whole affair is a trick and a fake. This has not been demonstrated. On the other hand, neither has it been conclusively demonstrated that it is not.

NEW POTASH DISCOVERIES

IT is already an established fact that potassium salts occur in Galatia, Hungary, Tyrol, Russia, Holland, Florida, and Persia. The United States Geological Survey has not yet been able to locate the reported Florida deposits, concerning which several press notices have appeared. The latest German discoveries are located in Alsace, close to the French boundary, and the potassium deposits there will probably extend across into France, as has been the case with the salt wells.

There still comes the surprising information that potassium salts have been found in the vast Empire of China. Although this news might at first seem incredible, it has been a well-known fact for some time, but kept secret by interested parties. Samples of these salts have been tested by a chemist connected with the Potassium Mining Syndicate, and the results have given a large percentage of chloride of potassium.

All particulars, especially the localities of the discoveries in China, are naturally withheld by the combine. Should the mining of the potassium salts in China be successful, the western part of Amer-

NEW POLES FOR TROLLEY WIRES.
Novel plan of construction used on Connecticut line.

ica will first come in question as a consumer. The salts could be delivered there very cheaply, as the wages of labor in Chinese mines is one-tenth of those in German mines, and especially the cheap ocean freight to the west coast of America will be an important factor.

WHY DO WE NOT GROW CORK?

WE are going to grow our own cork before long. At all events, the government hopes so. It is importing a lot of acorns of cork oaks from Spain, and will plant them experimentally in southern California and Florida. In both those regions, it is thought, the tree ought to thrive. In this business the Forest Service and the Plant Bureau are coöperating. The latter has produced in its experimental gardens at Chico, Cal., 2,000 seedling cork oaks, which are to be set out in the Santa Barbara and Monterey national forests, and also at Point Loma. If they do well, no effort will be spared to promote the development of the cork-growing industry in this country, and it may become one of the important ones.

INDIAN WOOD-CARVER.
Artisan of the Pacific Northwest and some of his products.

BRANCH OF THE CORK OAK.
Valuable tree that may be grown profitably in this country

INDIAN WOOD-CARVERS

THE Indians of the Pacific Northwest have always possessed considerable skill in wood-working and in carving of bone and ivory. Before the advent of the whites and the introduction of iron tools, everything in the nature of wood-working and carving was done with simply the aid of stone axes and bone hand-implements of a very crude kind.

Planks four feet wide by ten feet in length, cut from a solid log with these primitive tools, and numerous carvings of considerable merit, have been preserved. Graceful canoes, fifty feet and more in length, fashioned from a single tree by the same laborious methods, were observed by the early visitors to this section.

While the Indians of today make use of modern tools, their methods of work have changed but little from those employed at an early date and their finished product retains much of its former quaintness and distinctive characteristics. The illustration at the bottom of this page gives a good idea of the work and of one of the workers.

THE SINGER'S FLAGSTAFF.
Method by which big pole was fastened at top of high New York building.

TELLS STORY OF THE WIND

AT the meteorological observatory at Potsdam, a self-recording anemometer has been set up. Wind is simply air in movement, and the pressure that this more or less rapidly moving air exerts upon a certain area, can be measured. In the case of the windmill, the wings of the mill move more swiftly in proportion to the power of the wind. This anemometer is not unlike the windmill. It consists of horizontal, easily rotating crossbars, on each of the four ends of which a cup half spherical in shape is fastened. The wind catches in these cups and so turns the crossbar. From the crossbar, a rod goes into the instrument room. The rotation of the cups works a mechanism that moves a strip of paper upon which the velocity of the wind is plotted. The direction of the wind is also marked by the apparatus, as the vane is connected with the registering sheet. It is a simple matter with this apparatus to read at any time, the direction and the velocity of the wind.

NOVEL WIND MEASURE.
German observatory has new form of anemometer.

AN OSTRICH STEED.
As photograph shows, this bird is capable of carrying a man easily.

A FOLDING DRUM

THE accompanying photograph shows a patent folding drum recently invented. This drum can be folded and placed in an ordinary suit case, thereby saving the trap-drummer considerable trouble in carrying it about. This drum can be put together in three and a half minutes, knocked down and sacked in three minutes. Such a drum has been needed for some time. A drummer can carry a full line of traps and two drums in a suit case.

TRAMWAYS VERSUS THE MOTOR BUS

TRAMWAYS, as far as London is concerned, it is believed, have practically reached their limit of development, but the motor omnibus is probably only in its infancy. In narrow streets the speed of the tramway is greatly reduced, and municipal authorities, it is stated, have been compelled to appeal to ratepayers to patronize their own tramways. In the case of the omnibus, if a certain route is not remunerative, a transfer can be made to another line of travel, and it is in every respect more adaptable to London conditions than the tram car. The report of the British Board of Trade states:

A FOLDING DRUM.
Invention of F. E. Thompson, Lake City, Florida, for bandman's use.

NEW DIVER'S HELMET.
Equipped with telephone and electric light for submarine work.

As rivals to tramways motor omnibuses are likely to become more formidable than hitherto, since they will be cheaper to work and will travel longer distances. Tramways have long since reached a stage at which there would appear to be little room for further improvement either in efficiency or cheapness. Motor omnibuses, on the other hand, are only beginning to show their capacity for dealing with traffic in large volume.

LAMP FOR LUMINOUS SIGNS

THOSE huge dioramas which have lately been used for advertisement purposes have proved a powerful attraction to the passer-by. Now in order to utilize this same advertising method with more modest means, a firm of Parisian constructors have designed a projection apparatus which works quite automatically and can be used by any commercial firm for the projection of luminous advertisements following up one another in rapid succession.

The apparatus mainly consists of an electrical projection lamp around which there is arranged a circle of boxes receiving each a lantern-slide of any one of the usual sizes.

The carriages supporting these boxes travel on a circular rail, each slide being brought in succession, by a set of double ratchet wheels, between the condenser and the objective. The views follow up one another in succession as long as the motor is rotating, and as the apparatus can contain one hundred different views, a complete revolution, bringing all the views on the screen, is effected in thirty to forty-five minutes, according to the speed regulation of the motor.

AUTOMATIC MOTION-PICTURE. Advertising device invented by a Frenchman.

ARRANGEMENT OF PICTURES. New luminous sign that is attracting attention.

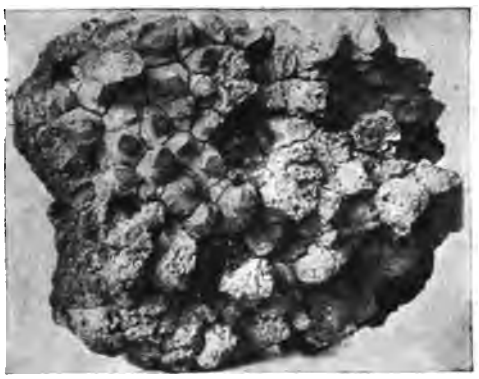
NEW PAPER MONEY

THE slang term "velvet," applied to money, may become a properly descriptive expression, if experiments now being made by Treasury officials turn out to be successful. Instead of being crisp, the money to be produced by the government Bureau of Engraving and Printing will then be soft and velvety. These experiments are being made for the purpose of demonstrating the advantages of such paper. By the new process, it will take sixty days less to manufacture a bank note than by the present method. The chemical solution employed not only renders the money soft and pliable, but also makes it non-shrinkable. The solution acts as an antiseptic and conservative. When applied to old documents, it seems to knit the fiber together and prevent further decay. By the process of printing paper money now in use the paper has to be thoroughly soaked in water. While it is in this soaked condition, one side of the paper is printed. The sheet is then placed in a steam room and kept under high temperature for thirty days, the time necessary for the ink to dry. The sheet is again soaked, as in the first instance, and the reverse side of the bill printed. The thirty days drying process then has to be repeated. In cases where a third impression on a bill is necessary, when the printing is done in two colors, the wetting is again repeated, and another month must be consumed. In printing bills on paper treated by the new process, wetting is unnecessary, the ink being dry within forty-eight hours.

A NOVEL WALL-SAFE. One of the late forms of protection for household valuables.

MOSQUITO PROTECTION. Headgear worn by engineers who work in the tropics.

AN HISTORIC CHURCH. St. Boniface Cathedral, at Winnipeg, whose chime was commemorated in verse by Whittier.



A PIECE OF CARBONITE MADE AT LOS ANGELES, CAL.
This substance is over 98 per cent carbon, and is harder than emery.

FLOUR-MILL'S GRINDING-ROOM.
Finished in Italian marble and kept absolutely spotless, this is one of the finest of a fine mill's features.

TESTING AN ATHLETE'S HEART.
X-ray apparatus used in Berlin to show results of violent exercise.

BETTER THAN CHARCOAL

A NEW process has been devised called the Lowe process, that will convert any carbonaceous material, particularly crude oils, bituminous coals and wood, into two most essential products, a definite fixed combustible gas and a hard carbon or coke. The hard product obtained from wood is called carbonite and is far superior to charcoal, and there is no loss in bulk in making the "mineralized wood," as it is called. A given quantity of wood when so treated, by actual test will last many times as long as when burned in its ordinary state.

SAVING SECONDS IN A MILL

A FLOUR mill is like a watch: it all must run or none can run, for one machine is dependent upon another for supply. It is also stated that it takes at least four hours after starting the power for a mill to get into proper running order, for each machine must be heated by friction before its best work can be done. For this reason perhaps, more than any other the flour mills run twenty-four hours each day, shutting down but a few hours on Sunday to allow the machines to be cleaned. Minutes, to the miller, are dollars and cents: therefore, all possible is done to save time. Unique indeed, is the manner by which men travel from floor to floor. Upon arriving at the mill the men stand in line at the foot of a large endless leather belt running between basement and attic. On this belt about every ten feet there are large iron rings, and some seven feet below each there are wooden steps. As the ring rounds the pulley in the basement, the nearest man snatches it, and leaping quickly upon the wooden step, is drawn swiftly upward, story after story, through a small hole in the cement ceiling to his destination. In descending, men cling to the opposite side of the belt.

NOVEL FLYING-MACHINE

THE principles of bird flight are being adapted to man's use in Professor H. La V. Twining's ornithopter. Professor Twining, who was one of the judges of the Aviation Meet in Los An-

geles, is a recognized authority in aeronautics and it is believed that he will solve the problem of flying in an entirely new manner. Like many of the other Western inventors, Professor Twining has been hampered by the lack of proper motors and the machine shown is operated by hand power and, while it can make progress over the ground by aid of the wing motion, it has not succeeded in flying. There is hardly any doubt, however, that the flight of the bird can be successfully imitated. Professor Twining was operating his novel air craft when this picture was taken.

LOS ANGELES FLYING-MACHINE.
One local device brought out by the aviation meet held there recently.

CURIOSITY IN ROCK

A CURIOUSLY shaped rock, bearing the imprints of what is apparently a man's foot, a woman's feet and child's right foot, was found recently by Alexander Crane in the Seminole Mountains in Oklahoma. The rock itself is in the shape of a man's foot with the heel broken off. Geologists who have examined the rock say it is without doubt several thousand years old.

CURIOUS OLD CARVING.
Lizard Rock, near Cuernavaca, Mexico, on which is a carving of a reptile, believed to be 1,000 years old.

LIBRARY ELECTRIC CLEANER

THE removal of dust from books and documents stored in libraries, archives and files is an especially important task both for aesthetical and hygienic reasons, and with a view to preserving this valuable material. Now, the primitive method so far in use only insured an insufficient removal of the dust, while entailing a considerable waste of time and much danger to the health of the workers. The use of electrically operated dust removing pumps—vacuum cleaners—has first afforded a method which, while being incomparably more thorough and expedient, is perfectly in keeping with all sanitary considerations.

These pumps are in many cases installed permanently mostly in the cellar of the building, being connected to a system of conduits, the branches of which are led into the several stories and rooms. To this system of conduits are connected, by means of a transportable length of hose, the vacuum cleaners, the mouth pieces of which are carried over the objects to be cleaned.

VACUUM CLEANER FOR A LIBRARY.
Useful permanent application of electrical dust-remover to a big stack-room

BUILDING HAULED BY CATERPILLAR ENGINE.
Latest application of the new form of traction engine.

HOUSE MOVING WITH AN ENGINE

TO demonstrate the efficiency of the caterpillar traction engine nothing could be more striking than the feat shown herewith of moving a house bodily. This structure is an office building being used by the Los Angeles Aqueduct in the desert near Mojave. The caterpillar engines, which were first used with great success in the Boer War, may be said to carry their own road with them. The flat chains, which take the place of rear wheels on this engine, will run right across a rough country full of ruts and hillocks, and are quite independent of roads. Beside this little house-moving stunt, the caterpillars are in constant use as heavy freighters on the Los Angeles Aqueduct, and are giving service of a very satisfactory sort.

DIVINING-ROD EXPERT.
Westerner who finds water by the much discussed method.

NEW DIVINING-ROD STORY

A. L. HUNT, one of the city gardeners, of Oakland, California, uses the divining-rod to locate water. Whatever power or principle Mr. Hunt possesses in determining the location of water is an unknown quantity, but the most singular fact remains that six wells were sunk according to his directions, and a plentiful supply of water has been obtained from each. By his system Mr. Hunt tells at what depth water will be found. Without exception his calculations have proved correct.

Mr. Kamond, superintendent of parks at Oakland, says of him: "The most forcible argument in Mr. Hunt's favor regarding water-finding is in Adams Park, where the city some two years ago bored down over 200

RAILWAY AUTO.
One of the many devices that are displacing the old handcars.

NEW AUTO FENDER.
Rubber tube arrangement for throwing person from the path of the car.

A CENTURY UNDER WATER.
Remains of musket, mallet, and coins recovered from sunken British warship after 129 years.

ply one hundred and fifty feet distant from the location of the city's first experiment and failure to get water. In this case, as in all others, Mr. Hunt specified the depth at which we could get water, designating such depth at from fifty to fifty-five feet. We located eight feet of water gravel at from forty-six to fifty-four feet."

TANKS TO RAISE SUNKEN VESSELS

THESE are not huge oil or gas tanks, as might appear to the casual observer, but are four of the large pontoons or canalons which are being used in a new scheme for raising sunken vessels. They form an important part in a new invention which promises to revolutionize marine wrecking operations.

feet without getting water. Subsequently Mr. Hunt located a good water supply one hundred and fifty feet distant from the location of the city's first experiment and failure to get water. In this case, as in all others, Mr. Hunt specified the depth at which we could get water, designating such depth at from fifty to fifty-five feet. We located eight feet of water gravel at from forty-six to fifty-four feet."

FROM 300 B. C.
Ancient Greek vase, with sponge growing from top, recovered off Syra by divers.

BENT PROPELLERS.
Curious accident that recently happened to a Pacific steamship, that was docked at San Francisco.

These canalons which are fourteen feet in diameter and thirty-five feet long, containing over four thousand cubic feet of air each, are allowed to fill with water and sink by force of gravity to the side of the submerged boat. The canalons are then made fast to the boat by strong steel cables, being directed to the point of contact on the boat, where wanted, by the same strands, which are pulling and guiding cables combined. The submerged pontoons are next connected with powerful air compressors on the surface, and the water forced out through automatic valves by air pressure. The valves, which allow the water to be forced out of the canalon but permitting none to enter, are the key to the whole invention. After a sufficient number of canalons are sunk and attached to the boat, the water is driven out of them all and the air raises the vessel to the surface.

FROM SPANISH ARMADA.
Carpenter's plane recovered by divers from Vigo Bay, where the vessels went down in 1588.

NEW SALVAGE SYSTEM.
Pontoons, used for raising of sunken vessels, are filled with water and sunk beside the vessel, then fastened to it, and pumped out, till they raise their burden to the surface.

MAN ON MULE.

BOY ON HORSE.

SWAN AND RIDER.

LIVELY DOG OF STONE.

PORTION OF JOINTED FIGURE.

APE EATING.

ANCIENT DOLLS

ON this page are reproduced some remarkable specimens of dolls recently added to the collection in the British Museum. They are images from Greece and Rome and were undoubtedly toys at some period of their existence. Most curious among them are the figures of the mules and rider with baggage upon their backs. There is a good deal of life in some of the figures, particularly the dog, and the rider on the swan. The attitude of the feeding ape also is very like to nature. The jointed figure in the center of the page reminds one strongly of the dolls of modern times which have been made upon exactly the same principles and which are supposed by people generally to be entirely modern inventions. The skill evidenced in these dolls seems unusual.

BOWL OR VASE.

MULE LOADED WITH BAGGAGE.

THE DESTRUCTIVE ROSE

PEOPLE who have not visited California can not realize the tropical, almost jungle-like growth of its flora. A cottage covered with white rose bushes, forming a perfect mass of foliage and bloom, is no very uncommon sight in some of the California cities. In fact the white climber is such a rapid grower that it is sometimes destructive. Cases have been known where such a climbing rose would pull a house out of plumb or wreck a front porch. It can be readily seen that the weight of an enormous plant would be great enough to affect any building that was not of the strongest construction. The fact is that a tender shoot growing old and tough often destroys its support.

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THE RULERS OF THE EIGHT GREAT POWERS.

THE TECHNICAL WORLD MAGAZINE

VOL. XIII JUNE, 1910 NO. 4

RACIAL FERTILITY AND WAR

By

HENRY M. HYDE

THE world is at peace. Around all its circumference there is nothing to actively disturb the harmony of nations more serious than a tin-pan revolution in Central America. Yet not in a hundred years has there been a situation so threatening. Not since Napoleon spilled his bottle of blood over the map of Europe has civilized mankind faced possibilities so tremendous in their horror.

In the leading newspapers and the great reviews of Europe the prospect and the probabilities of the coming war have taken the place of the weather as the regular topic of discussion. As the base-ball fan watches the daily struggle of the rival clubs in late September, so the whole fevered continent is keeping score on the mad race between Germany and England in the building of super-Dreadnoughts. Each of these ironic pledges of peace takes ten million dollars permanently from the public wealth and adds a tenth as much to the annual budget for maintenance, repairs and depreciation. Three years ago England had four Dreadnoughts in the water; Germany had none. By the end of 1910 the score will stand seven to seven. Great Britain, even with a reluctant Liberal government at the helm, has made definite plans for the completion of sixteen such vast engines of war within the next three years. Germany's plans—only part of which are made public—are supposed to be on an equally gigantic scale.

It is difficult to realize the state of apprehension and alarm into which these warlike preparations for keeping the world at peace have thrown the public mind, both in Great Britain and the Teutonic empire. Englishmen, forced to abandon the two-power standard for their navy, alarmed at the flaming of revolt in India and Egypt, have lived in a nightmare for two years. Obsessed by the spectre of an invasion of their island by the German horde of 1,300,000 trained soldiers, they have fought for places at the theatre to see that silly play, "An Englishman's Home," wherein the troops of the thinly disguised "Emperor of the North" surprise John Bull in his library. Panic-stricken at the thought that they have an army of only 265,000 men, more than half of whom are serving over seas, grave English generals and colonels have organized little squads of "Boy Scouts" and "Girl Scouts," and gone trapesing with these children over the lovely English country on Saturday half-holidays, teaching them the art of war. They have called inter-colonial conferences and laid the danger before men from Australia and Canada. And both of these self-governing dependencies have started to lay down navies of their own. For the first time in its history phlegmatic Albion,

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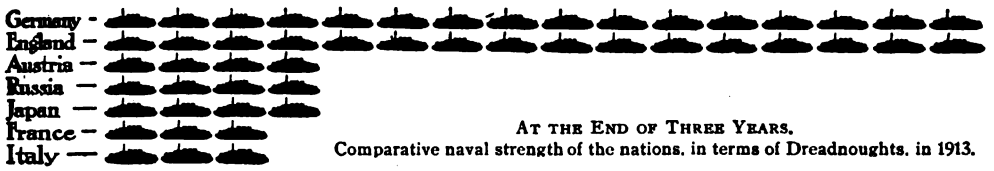
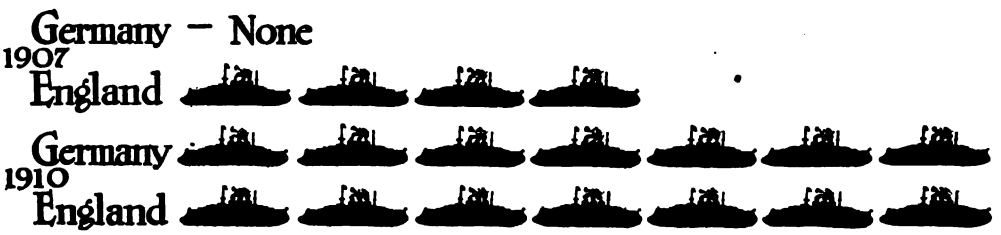


AT THE END OF THREE YEARS.
Comparative naval strength of the nations, in terms of Dreadnoughts, in 1913.

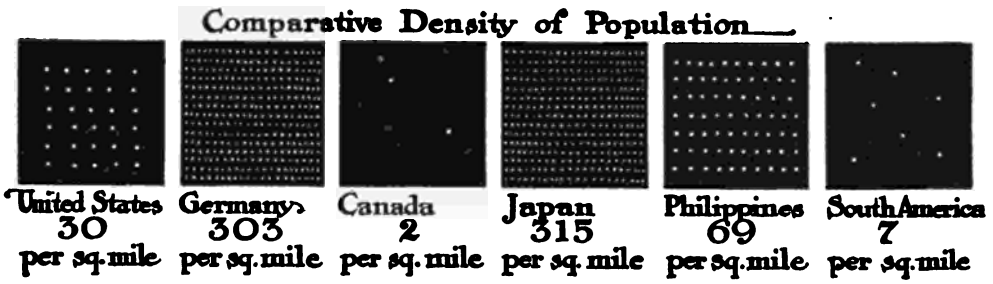
so long mistress of the seas, has become hysterical.

At the English army manoeuvers the army in opposition is always called "the Germans," when the officers of the attacking corps wish to put fresh dash and spirit into their men. Last June more than 350 British warships were massed in the North Sea off the eastern coast of Scotland. One of the three fleets into which this huge flotilla was divided was chosen to represent a German fleet of invasion and every possible method of attack was tried and the check to it devised.

In Germany the case is somewhat different, yet equally alarming. Because it is the younger, the growing power, feeling that its rise marks the decline of its ancient rival, the German attitude is one of half-contemptuous determination, rather than anything approaching panic. Every evening, on every German battleship, the officers at mess are supposed to drink, grimly, "To The Day!"—the day when their War Lord flies at the throat of England. When Count Zeppelin demonstrated that in his great air-ship he could fly as far as from Berlin to London, carrying enough high explosives to bring the greatest and proudest city in the world to its knees, a fire of triumph swept through the empire. Out of his little, Hans poured a shower of copper coins into a fund to build a whole fleet of such cloud-compelling destroyers. When before the last Peace Conferences at the Hague, the British sounded the powers as to an international agreement looking to the voluntary limitation of armaments, Germany not only refused to consider it but declared that she would take no part in the conference if such a proposition was even presented. Which was only natural, since to stop the building of warships at the present point would be to leave Great Britain the undisputed mistress of the



COMPARATIVE NAVAL STRENGTH OF ENGLAND AND GERMANY IN TERMS OF DREADNOUGHTS.

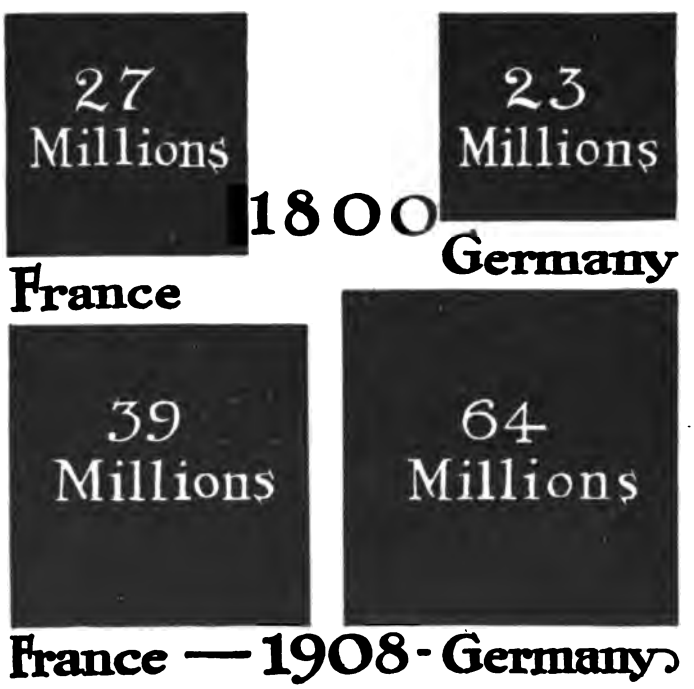


seas and thus all Germany's recent naval activity would go for nothing.

The other great powers of Europe are already lined up on one side or the other of the great struggle to keep the peace. France, with the fires of revenge for '70 still only banked, is the willing ally of anybody against the Teutons. Rich and thrifty—in gold, if no longer in men—she approved more than a year ago a naval program which includes the spending of $600,000,000 for warships within the next nine years. Japan, England's eastern ally, is recruiting her strength after the great victory over Russia. And Russia, itself, thrown by the force of events into alliance with its recent foe, laid in June last the keels of four super-Dreadnoughts which can only be counted in the anti-German armament.

Germany, on its side, has the backing of the Drei-bund, the other members of which are Austria and Italy. Austria, where the pan-Germanic feeling is strongest, has already four Dreadnoughts under way and even poverty-stricken Italy has laid the keels of three such monsters.

In the United States hardly a month passes without some man of prominence sounding a warning of the danger of war with Japan. Here, as also in the Far East, hundreds of millions are being spent in building vast steel engines of destruction. A faint idea of the awful cost of armed peace the world over, may, perhaps, be gathered by considering in some detail what it has cost the United States, where the world-wide contagion has been least virulent. For the eight years previous to the Spanish war the average annual cost of the army and navy was a trifle more than $51,000,000. For the last eight years the average annual cost of the army and navy has been more than $185,000,000—an increase of 360 per cent. The extra money spent on preparations for war in the United States alone since 1902 amounts to nearly one



A Study in Race Fertility.
Showing how Germany has outstripped France in population during the last century.

Estimated Cost of Panama Canal

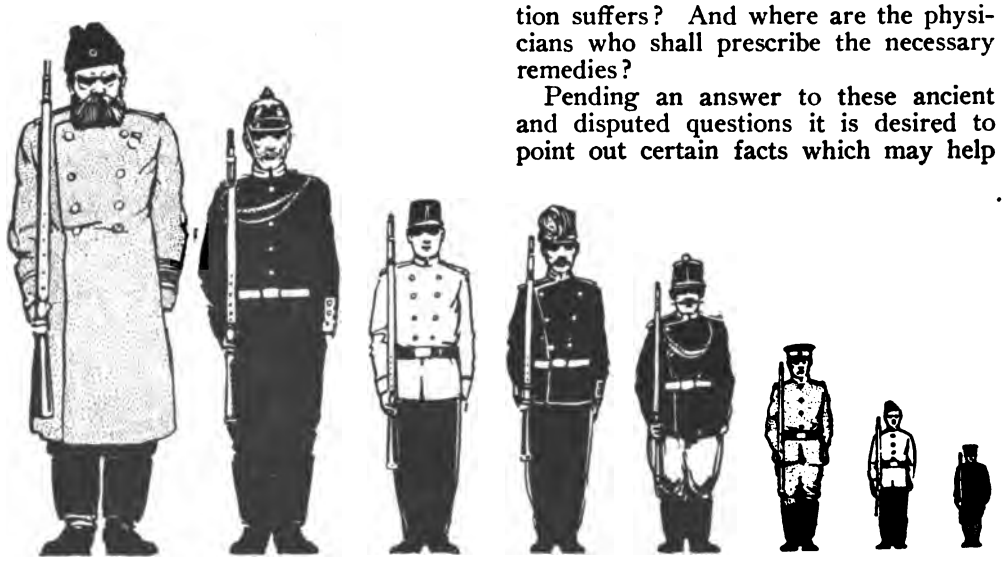
Cost of U.S. Army & Navy for Two Years.

and one-tenth billions of dollars, a sum which would much more than pay the national debt; it would pay the estimated cost of the Panama Canal, three times over, including the price paid the French government. A deep channel down the whole length of the Mississippi and a waterway from the lakes to the Gulf, every ship canal and waterway projected or discussed in the United States—all might have been built and paid for out of the added cost of the army and navy during the last eight years. Every family in the country has been forced to pay $60 in additional taxes to meet this extraordinary expenditure. And the United States, it should be remembered, is the richest nation in the world, the one best able to meet the drain. Also the total expenditure here is actually much less in proportion to wealth and population than in any of the other countries mentioned. Germany, for instance, with about two-thirds as many people, keeps 600,000 soldiers always under arms.

Meanwhile in Great Britain's proud capital city one out of every four citizens who dies is buried in a pauper's grave. And the present government is all but shipwrecked in its efforts to find work for a multitude of half-starving unemployed and to find money to pay old-age pensions to another multitude of feeble and dependent workingmen and women. Over across the North Sea the German masses, marching in constantly growing numbers under the banner of socialism, are ridden down and bayoneted in the streets of Berlin by the soldiers they are taxed to support. Even in the United States goes up a bitter and loud complaint against the increased and increasing cost of living.

What is the matter with the world? What is the disease from which civilization suffers? And where are the physicians who shall prescribe the necessary remedies?

Pending an answer to these ancient and disputed questions it is desired to point out certain facts which may help



COMPARATIVE SIZE OF THE ARMIES OF THE WORLD.

THE *RHEINLAND*, GERMANY'S LATEST DREADNOUGHT.

to explain the present situation and to ask whether, because of these facts, the nations may not, almost in spite of themselves, be driven into war?

In 1800 France had 4,000,000 more population than Germany. At that time both nations occupied approximately the same amount of territory, about 200,000 square miles each. The density of population in France was 134 to the square mile; in Germany it was 113.

In the last hundred years the fertility of the German nation has been so great that, in spite of the fact that it has sent more than 6,000,000 emigrants to the United States and millions more to other foreign countries, it has increased its home population to 64,000,000, nearly triple the number in 1800. During the same period the population of France, which has sent practically no immigrants abroad, has increased by less than fifty per cent. And, it should be remembered, in spite of Alsace and Lorraine, the territory of the two nations has remained practically the same — approximately 200,000 square miles each.

At present the density of population in the German empire is 303 to the square mile. What that means may be grasped by considering that if the United States was as thickly populated as Germany is at the present time we should have 900,000,000 people—ten times our present population. In other words the present density of population in the United States is only thirty to the square mile.

If there were ten men to the present one on every acre in the United States some of us would certainly think of moving. Indeed there is already some complaint that the country is getting overcrowded. This year, alone, nearly 100,000 farmers from the western states moved across the line into Canada, where land is still plenty and unsettled. If every man, woman and child in the United States was shut up within the limits of Texas, the Lone Star State would be little more crowded than is Germany at the present time. Put the strongest navy in the world across the Gulf from Texas and line the boundaries of the state with camps of armed men and

one may get a fairly good idea of the German situation.

But—granted that Germany now holds all the people it can support—where may the loyal German go and remain under the German flag? The German colonies are small, scattering and not well fitted for the home of white men. There are hundreds of thousands of Germans in various parts of South America, where the country is still undeveloped. But the United States holds all this continent under the protection of the Monroe doctrine and forbids the hoisting of a foreign flag. Almost all the rest of the undeveloped world which is counted a white man's country is part of the empire of Great Britain.

Where and how shall the immensely virile and fertile Germanic race find a new home and a new empire over seas? Or will it, with the greatest army in the world at its command and a tremendous war fleet in the making, sit tight within its narrow boundaries at home until famine and pestilence sap its vitality and reduce its numbers? It may do that, it may allow millions of its sons to renounce their allegiance to the fatherland, or it may—the last terrible alternative is the one of which the world stands in dread.

In the Far East the case is exactly the same. Japan, penned in its narrow islands, with nearly fifty millions of warlike people crowded into 160,000 square miles of land, is already overflowing into Corea. Even with conscious design and mere mercenary ambition left out of the question, it is impossible that the race should not look with envy on the fertile Philippine Islands to the South, which have more than two-thirds the area of their own territory and are populated by only a few millions of people, many of them savages.

If it is possible to understand the almost irresistible impulse which drives the Japanese to seek outside their present boundaries a less crowded home, let it be remembered that, if Formosa be counted with the other Japanese islands, the density of population in the Island Empire is almost the same as in Germany!

Is it true then that after all the talk of commercial supremacy, national honor and high ideals, the real cause of the waiting war may be found in the primal instinct of swarming from the overcrowded hive? Is racial fertility at the bottom of the coming struggle?

THE TOWN HALL AND PUBLIC SQUARE AT TEHUANTEPEC.

GREAT RIVAL OF PANAMA CANAL

By

CHARLES FREDERICK CARTER

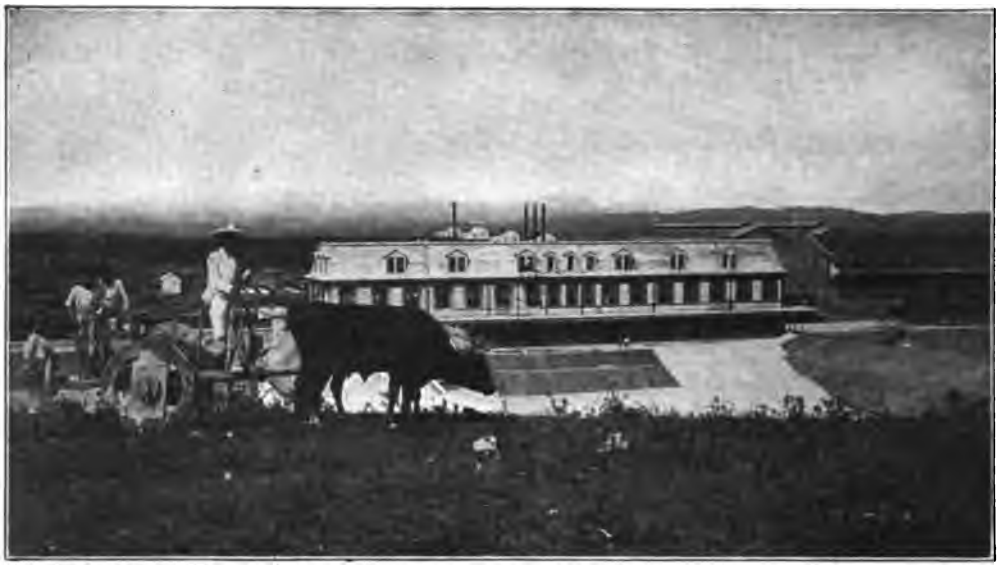
WHAT shall it profit a nation to squander more than a third of a billion dollars in digging an inter-oceanic canal when another nation already has in successful operation a rival transportation line that can cut rates below the possibility of competition by the canals and still make a profit?

This is the conundrum that has confronted the people of the United States since January 1, 1907, when Mexico opened the Tehuantepec National Railway to traffic. It will continue to confront them so long as the railway remains in operation in spite of all the rhetoric that can be touched off in Congress or out of it.

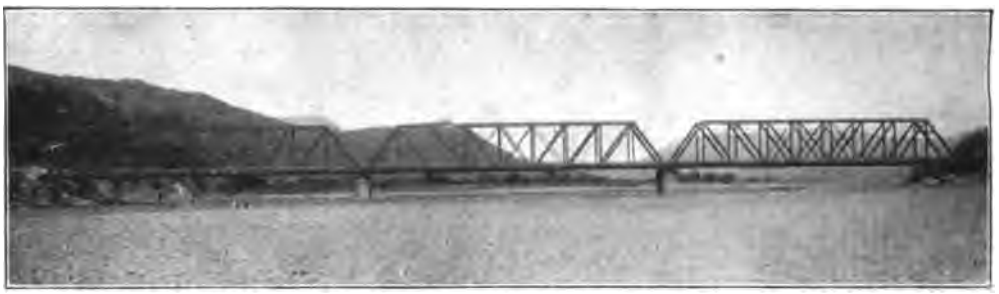
A TEHUANTEPEC BELLE.

On paper, of course, water transportation can put the railroads out of business with one hand tied. It has been demonstrated beyond the possibility of successful contradiction again and yet again that a steamship, or a steamboat or even a canal boat, can haul freight so much cheaper than a train that the latter can not even earn interest on its bonds. As a matter of prosaic history, however, it will be remembered that the railroads even in their crude days of undevelopment, simply took all the traffic away from the canals, which had had some years the start of them, leaving the canal boats to rot and the canals themselves to degenerate into duck ponds.

Years later, when the railroads were still puttering along with ten ton cars dragged by little old eight



GENERAL OFFICE BUILDING OF THE NATIONAL TEHUANTEPEC RAILROAD AT RINCON ANTONIO.



TEHUANTEPEC BRIDGE—A LINK IN THE CHAIN BETWEEN THE TWO OCEANS.

MERCHANT VESSELS IN PORT AT SALINA CRUZ. THE PACIFIC TERMINAL OF THE RAILWAY.

wheel locomotives they made it so hot for the lordly steamboats that were churning up the waters of the Mississippi, Missouri and Ohio that the boats disappeared so utterly that even the pattern has been lost. Yet Congress lavished a million dollars in river improvements for every thousand dollars voted by counties and municipalities in aid of railroads.

True, a steamship with its five or six thousand tons of cargo is a different affair from a Mississippi steamboat. But so, also, is a modern sixty ton steel car different from the little wooden band-boxes of twenty years ago. And it must not be forgotten that it costs money to run a steamship. Every mile of ocean traversed costs a certain definite ratio per ton of cargo for fuel and oil and food and wages for the crew. Storms are so rudely inconsiderate of the necessities of commerce that accidents are even more common at sea than on land, if one may believe the melancholy statistics tabulated by Lloyd's. Moreover, even a steamship wears out, and the wear and tear, like the cost of fuel and wages, bears a pretty definite ratio to earnings. This tax is as unavoidable as the railroads' maintenance of way expenses.

How the Sugar Boats Are Unloaded at Salina Cruz.

Leaving out of consideration, then, the possibilities of disaster at sea or on land, and getting down to operating expenses alone, it cannot be denied that the expense per ton per mile of a steamship going to the Panama Canal is just the same as if the vessel were bound anywhere else. The relative merits of the Panama and the Tehuantepec routes, therefore, are very quickly reduced to a mileage basis. On this basis the advantages of the Tehuantepec route are at once apparent.

The Tehuantepec National Railway crosses the Isthmus of Tehuantepec, meaning in good Aztec "The Mountain of the Man-Eaters," which at its narrowest part is only one hundred and twenty-five miles wide. The Isthmus is in the State of Oaxaca in southern Mexico, forming that part of the Mexican peninsula which swings around until it lies east and west, forming part of the southern boundary of the Gulf of Mexico and connecting the peninsula of Yucatan with the rest of Mexico. To be still more exact, it lies between 16 and 18 degrees north latitude and 94 and 96 degrees west longitude. With the exception of the Isthmus of Panama it forms the slenderest strip of territory on the western hemisphere dividing the waters of the Atlantic and the Pacific.

The point that has focused attention on this narrow strip of land for the last four hundred years is the fact that it lies six hundred miles nearer to the world's main traveled road than the Isthmus of Panama; and as the greater part of the world's traffic is between points in the northern hemisphere the distance is doubled on the average voyage, and in some cases more than doubled. The saving in distance by the Tehuantepec route over the Panama Canal on some of the principal trade routes may be seen by a glance at the following table:

Route from	Total Distance Miles	Excess over Tehuantepec Route Miles
New York to Hong Kong via		
Cape Horn	20,379	8,777
Cape of Good Hope	16,945	5,343
Suez Canal	13,596	1,994
Panama	12,953	1,351
Tehuantepec	11,602	.....
New York to Honolulu via		
Cape Horn	15,826	9,163
Panama	7,939	1,276
Tehuantepec	6,663	.....
New York to San Francisco via		
Cape Horn	15,687	10,797
Panama	6,063	1,173
Tehuantepec	4,890	.....
Liverpool to Yokohama via		
Cape Horn	19,400	5,945
Cape of Good Hope	17,653	4,198
Panama	14,540	1,085
Tehuantepec	13,455	.....

ELECTRIC CRANES IN USE AT SALINA CRUZ.
The roofs of the box cars are removable.

The distance from the mouth of the Mississippi River to the Gulf terminal of the Tehuantepec Railway is only eight hundred and ten miles; and the total distance from Chicago to the Pacific Ocean by that route, 1,875 miles. With "fourteen feet through the valley" Chicago should have rates to Pacific ports low enough to satisfy any reasonable shipper.

The average saving in distance by the Tehuantepec route over the Panama route to all places on the Atlantic coast of the United States and Europe is about twelve hundred and fifty miles.

This distance is a very serious handicap to a steamship that is trying to compete with a route made up of a railroad one hundred and ninety miles long connecting two safe and commodious harbore equipped with every appliance that ingenuity could suggest for the rapid and economical transfer of freight from steamer to car and from car to steamer.

Ocean freight rates are worth on an average a dollar per ton per thousand miles. The ordinary freight steamship makes about ten miles an hour, or two hundred and fifty miles a day, thus requiring five days more to go by way of Panama, assuming the time of crossing both isthmuses to be the same. It will take a steamer about one day to pass through the Panama Canal, while the cargo could be passed across Tehuantepec and loaded into another steamer in two days, leaving four days to the advantage of the Mexican route. The extra cost of the four days to a steamer with a five thousand ton cargo to go by way of Panama would be $2,000; adding the canal tolls would bring the total up to $10,000.

That this saving in actual cash by the Tehuantepec route is not merely an academic theory but a commercial reality has been demonstrated by more than three years of operation. The first demonstration was the diversion of a couple of hundred thousand tons of sugar per year that was formerly shipped from Hawaii by way of Cape Horn to New York and Philadelphia, saving more than thirty days time. The directness of the Mexican route is shown by the fact that a cargo which left Hong Kong April 8, 1909, consigned by way of Tehuantepec was delivered in New York May 31, making the time in transit fifty-three days.

In 1907 the Tehuantepec Railway car-

MARKET SCENE IN THE TOWN OF TEHUANTEPEC.

ried six hundred thousand tons of freight across the Isthmus. The following year the total footed up more than a million tons; and in 1909, although the figures are not yet available, it is known that this aggregate was increased by more than fifty per cent.

Our Mexican neighbors are not only getting ready to make things very interesting for the Panama Canal, but they

ONE OF THE PICTURESQUE VALLEYS ON THE ISTHMIAN ROUTE.

RICH PASTURE LAND SUCH AS THIS IS NOT UNCOMMON.

are even making the transcontinental railroads sit up and take notice. Freight from New York by way of Tehuantepec has been delivered in San Francisco in twenty-seven days; and in at least one instance twenty-three days, which is as good time as the transcontinental railroads can make. Freight is delivered in good condition; for the service is not only quicker, but it is also better than by the Panama Railroad, which covers the distance from ocean to ocean in 47.7 miles. Moreover, those Mexicans have had the audacity to adjust their rates on a basis that enables them to compete with the transcontinental railroads, not merely to Pacific coast ports, but also some distance inland therefrom as far north as British Columbia.

The Canadian Government found upon investigation that wheat could be shipped from Calgary, east of the Rocky Mountains, six hundred miles west to Vancouver, thence by steamship to Tehuantepec and across the Isthmus and delivered in Liverpool twenty per cent cheaper than by rail east to Montreal. Under these circumstances it is not to be wondered at that the Tehuantepec Railway carried $38,000,000 worth of freight originating at, or destined to, points in the United States in 1908, while the Panama Railroad carried only $12,000,000 worth the same year.

In order to make the route as attractive as possible to shippers the Mexican Government has arranged that all through freight may be carried across the Isthmus in bond so that there is no delay for custom house inspection and consular invoices.

The railroad now has twenty steamship connections, some extending from the east coast of Africa and Constantinople as far as the east coast of Siberia, China, Japan and the Philippines. Tehuantepec is not only part of the world's main traveled road for east and west bound traffic, but it is also a short cut from any part of the United States to the west coast of South America. Through Pullman sleeping car service has been established from the City of Mexico and Salina Cruz, the Pacific terminus of the Tehuantepec Railway, so that the journey of five hundred and twenty miles can now be made without change of cars or layovers in thirty-six hours. From Mexico

FLEET OF CANOES ON THE COATZACOALCOS RIVER, THE ATLANTIC TERMINAL OF THE ROAD.

City one may go to New York, Chicago, Pittsburg, Cincinnati, Boston, Cleveland or San Francisco with only one change of cars. Regular sailings from Salina Cruz furnish service, not only to South American ports, but also to Honolulu, China and Japan.

The Tehuantepec route, however, while prepared to care for all the passenger traffic that comes its way, is essentially a through freight route.

The railroad itself is up to the minute, with creosoted ties, eighty pound steel rails and rock ballast. In some places the rock ballast is five feet deep, not because money was no object, but because the ground was soft. It was a hard road to build, for north of the continental divide the weather puts in all its time raining except when the programme is varied with showers. The result is that in the course of its one hundred and eighty-nine miles the Tehuantepec Railway crosses eight hundred and sixty-two waterways, of which two hundred and twenty-five are spanned by steel truss bridges, one hundred and sixty-three by masonry arch bridges, while the rest are taken care of by pipe and box culverts. The reason there are no more bridges is because the engineers could find no room to place them. South of the range fewer bridges are needed because there rain is rare.

ELECTRIC CRANES IN OPERATION AT PUERTO MEXICO. A PORT ON THE GULF OF MEXICO.

There is a gradual ascent going south from Puerto Mexico, the Gulf port, to the Jaltepec River, seventy-nine miles distant. Here the ascent of the continental divide begins, the maximum grade south bound being sixty feet to the mile. Malatengo Cañon is entered thirty-eight miles from the Jaltepec River. A short

IN THE HEART OF THE ISTHMUS.

HARBOR AND PORT WORKS AT SALINA CRUZ.

distance beyond Chivela Pass is reached where the continental divide is crossed at an altitude of seven hundred and thirty-five feet. From here to the Pacific the descent is somewhat abrupt, the grades reaching a maximum of one hundred and sixteen feet to the mile. Two horseshoe curves and a tunnel were necessary to get down the range.

The troubles of the railroad men did not end with the construction of the line, for with the abundant rainfall and warm climate the vegetation is so rank that in a very short time it would overgrow the track and stop the trains if some genius had not thought of sprinkling it with crude oil. Tanks holding six thousand six hundred gallons are mounted on cars and the oil, heated to 210 degrees, is sprinkled at the rate of a thousand gallons a kilometer. Two applications of hot oil at a total cost of eighty dollars a kilometer are enough to discourage vegetation for an entire season. Also they lay the dust effectively; and as the locomotives burn oil there are no cinders and very little smoke. The Tehuantepec route is the one railroad on earth that can make good its claim to being dustless.

But the things that really make the Tehuantepec route count are the facilities for handling traffic rapidly, and therefore cheaply. The locomotives are the latest American consolidation type, weighing one hundred and thirty-four tons and having cylinders twenty-two by twenty-six inches. The freight cars, also of American build, are especially designed for the traffic they handle, for the roofs are made to slide back out of the way so that the huge electric cranes on the wharves can lift bales, barrels and boxes from the steamer's hold and deposit them in the car, or vice versa.

The old town of Coatzacoalcos, the northern terminus, has been re-christened Puerto Mexico. It is situated on the left bank of the Coatzacoalcos River a mile above its mouth. Surrounding swamps have been filled in, rank vegetation cleared away and a modern sewage system and water supply installed so that the town is now clean and healthful. The Coatzacoalcos River, which is two thousand feet wide and fifty feet deep at its mouth, and navigable to Minatitlan, a distance of twenty-four miles, forms a splendid harbor. The bar that blocked its mouth and made the harbor useless has been scoured out from a depth of fourteen feet to thirty-three feet by the construction of jetties four thousand feet

long, three thousand four hundred feet apart at the shore ends and six hundred and fifty-six feet apart at the sea ends.

Vessels can be brought directly alongside seven steel and concrete wharves with an aggregate frontage of more than a mile. On each wharf is a warehouse four hundred and twenty feet long and one hundred and ten feet wide, each capable of holding ten thousand tons of freight. On each wharf are railroad tracks on which cars to be loaded or unloaded can be run right to the steamer's side, while one is reserved for the use the interior basin. The inner harbor was built by dredging. It is 3,280 feet long and 925 feet wide with a depth of thirty-three feet alongside the wharves. The entrance from the outer to the inner harbor, one hundred and ten feet wide, is spanned by two swing bridges.

As there was no rock foundation on which to build the outer wall of the inner harbor the engineers had to provide one. They did it by building huge monoliths of concrete on the sand. Into three large holes in these monoliths men were sent who dug out the sand and mud allowing

TANKS OF PETROLEUM READY FOR TRANSPORTATION.

of electric traveling cranes of large lifting capacity, the steel booms of which reach through a radius of fifty-four feet.

Nature having failed to provide a harbor of any sort at Salina Cruz, the Pacific terminal, to shelter vessels from the fierce northers that sweep across the isthmus, it was necessary to construct both an outer and an inner harbor with wharves and a dry dock. Breakwaters aggregating more than a mile in length constructed of rubble topped with concrete blocks weighing forty and fifty tons each have been built far out into the sea, ending in a depth of seventy feet with the convex sides turned toward the sea. The entrance is six hundred and fifty-six feet wide. The outer harbor covers an area of one hundred and fifty acres. Across the rear of the protected area a line of wharfage extends, opening into the monstrous blocks to sink. When they had sunk the monoliths sixty-five feet into the sand they came out and filled the holes with concrete, making a solid rock wall 226 feet wide and as firm as the everlasting hills.

Twenty-six miles of side track have been provided at Puerto Mexico and twenty-two miles at Salina Cruz, so that sudden rushes of traffic can be handled without delay. As an example of the way things are done with the aid of modern port facilities, it may be said that in January, 1910, 4,711 tons of freight were discharged from a vessel at Salina Cruz, put into 156 cars and forwarded in one day. On that same day, 1,475 tons of light and bulky general merchandise was discharged from a vessel at Puerto Mexico in ten hours.

The headquarters of the road are at

Rincon Antonio, two-thirds of the way from Puerto Mexico to Salina Cruz, in a delightful location 750 feet above sea level. Here a model town has been built, with the best of sewerage, water supply and lighting systems. The railroad shops are the most complete in Mexico, all machines being driven by individual electric motors, the current for which is generated by steam raised by oil fuel.

Cortez was the first to perceive the advantages of the Tehuantepec interoceanic route four hundred years ago. After he had picked up everything that was not nailed down in Mexico this famous highwayman began to look about for other folk who needed robbing. Searching to the southward he entered the Coatzacoalcos River and started up it, expecting to sail right on over to the Pacific. Being disappointed in this he worked out a scheme for building a road across the divide on which to transport material and supplies wherewith to build a fleet on the Pacific for the conquest of South America. Charles V., King of Spain, was so fascinated with the scheme that he made Cortez a marquis and gave him several thousand acres of land in Mexico that he did not own. The road was built and used by the Spaniards, and it also came in handy for the gold-seekers bound for California in 1849.

Long ago the world progressed beyond the point at which an indifferent wagon road met the requirements of traffic; but Mexico was too busy with family quarrels to waste time trying to make money until Diaz became president in 1876. About the first thing he did was to try to get a railroad across the Isthmus of Tehuantepec. No fewer than three charters were granted in four years, to be followed later by others; but for one reason or another all failed to produce results. Some wanted to build a canal; and James B. Eads, the famous engineer who built the jetties at the South Pass of the Mississippi, wanted to construct a ship railway across the Isthmus on which

VALLEY COUNTRY ALONG THE TEHUANTEPEC RAILWAY.

THE TOWN OF RINCON ANTONIO, HEADQUARTERS OF THE LINE.

vessels were to be transported bodily from ocean to ocean on monster cars. The scheme was wildly impracticable, but Eads died with his faith in it unshaken.

Nothing was actually accomplished until some American contractors obtained a charter in 1892. The money ran out before the road was finished and still another contract was made under which the road was finally completed from ocean to ocean in 1894. It was so badly built that it was worthless, and besides, there were no harbors at either end. Still, not discouraged, the Mexican government entered into negotiations with Sir Weetman Pearson, head of the firm of S. Pearson and Son, the English contractors who had gained a great name through the successful construction of drainage works in the Valley of Mexico and harbor works at Vera Cruz.

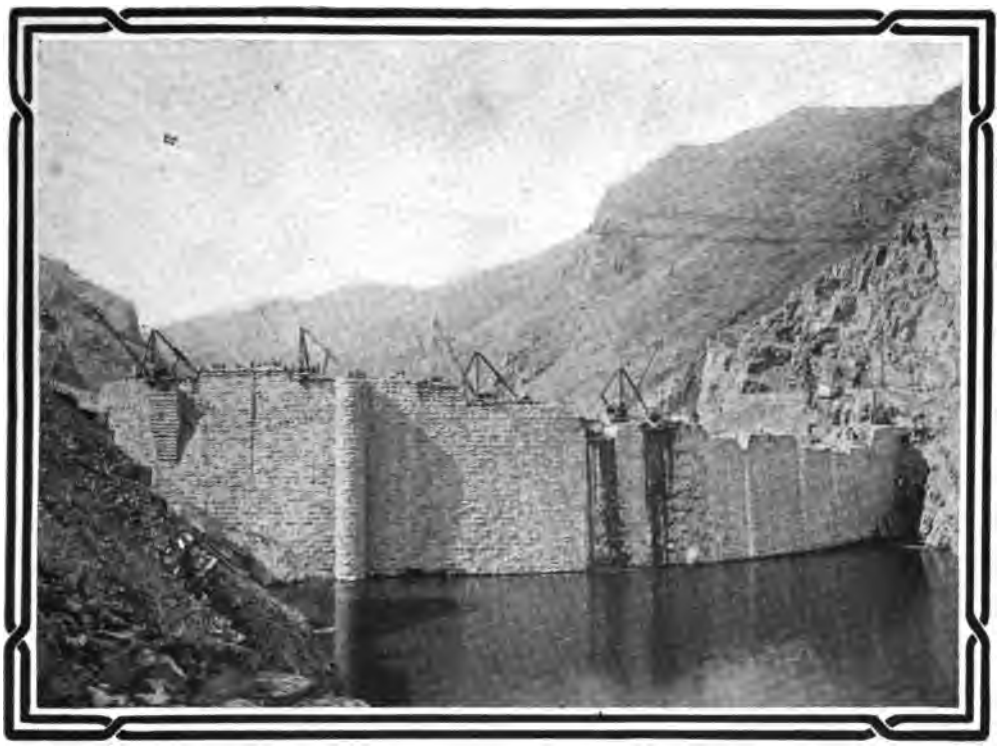
For the first time a national government and a private citizen of another nation entered into a partnership agreement by which the government was to furnish all the money for construction and half the capital needed for operation, while the contractors were to do the work at cost and furnish the other half of the working capital. The partnership runs for fifty-one years from July 1, 1902, and the Mexican Government gets 65 per cent of the profits for the first thirty-six years and then 68½, 72½, and 76½ per cent for periods of five years each. At the end of the last period the government takes full possession of the property.

The road was entirely relocated and rebuilt in the time allotted and this time adequate harbors with facilities for handling traffic were provided. January 1, 1907, President Diaz had the satisfaction of formally opening the world's highway, which he had been trying unceasingly for thirty years to secure.

While Mexico is earning dividends on her inter-oceanic short cut, the people of the United States are watching the cost of the Panama Canal grow. Up to date the increase has been more than 260 per cent, or from $144,233,358 to $375,201,000, and there will be abundant opportunities for further increases.

The situation has none of the elements of a surprise, for John F. Wallace, who was a great engineer when he consented to take charge of construction on the Panama Canal but was suddenly transformed into a very bad one when he found out what sort of a job he had undertaken and wanted to quit, told the United States Senate Committee on Inter-oceanic Canals all about it years ago. In the course of a great deal of enlightening information he said:

"I do not think you can over-appreciate the importance of protecting our future trade by heading off the possible development of the route by way of Tehuantepec. It goes without saying that it is much easier to hold a line of traffic than to get it away from somebody else after they get it once. I do not think that there are very many people who appreciate what the Tehuantepec route means if it is once established."



VIEW OF THE GREAT DAM FROM ABOVE, SHOWING PARTIALLY FILLED RESERVOIR.

FINAL WORK ON THE ROOSEVELT DAM

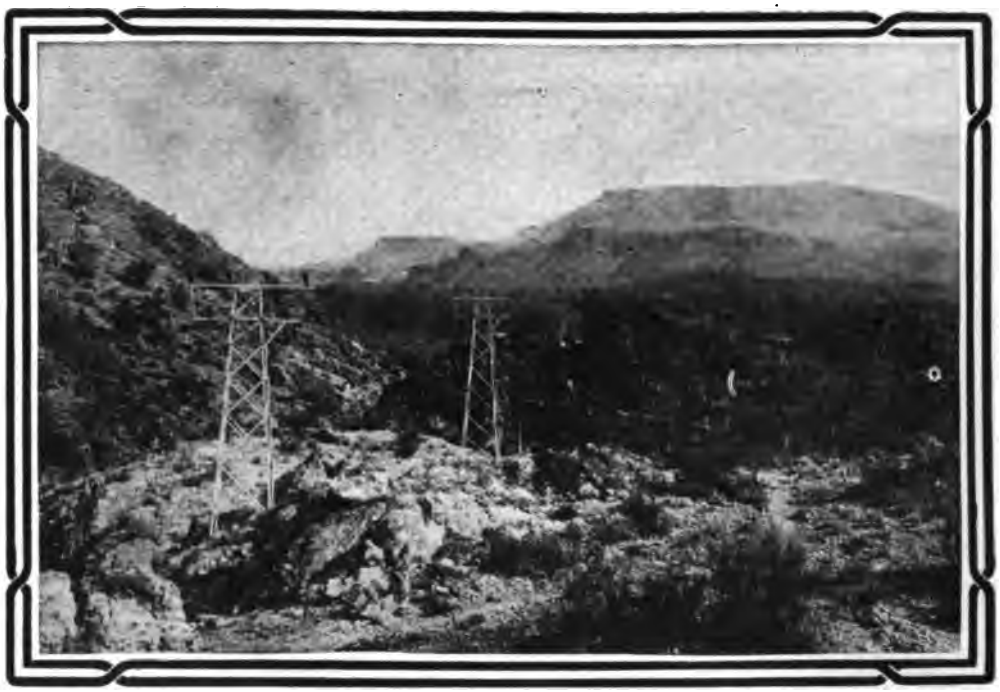
By

RENÉ BACHE AND RALPH E. JENNEY

UNCLE SAM is making a new departure. Up to now, on those arid areas of the West which are being transformed into garden spots by irrigation works built under the Reclamation Act, he has contented himself with furnishing water. But very soon he will start in to supply power, in the Salt River Valley of Arizona; and the first use made of the power will be to moisten 10,000 acres of land on the Pima Indian Reservation, which is to be divided into small farms and cultivated by the Pimas and Maricopas.

This, incidentally, will be an act of somewhat tardy justice and recompense to a tribe of Indians which since time immemorial has always been most friendly to the whites. They were peaceful and agricultural, raising crops of corn, beans, and squashes in the valley aforesaid, until, a few years ago, the white people went above them on the river, drew off the water through a big canal, and left their fields dry. Their ditches no longer brought the requisite fluid; their crops failed, and, deprived of their means of subsistence, they became beggars and vagabonds.

It is a matter of record that these Indians were never known to molest a



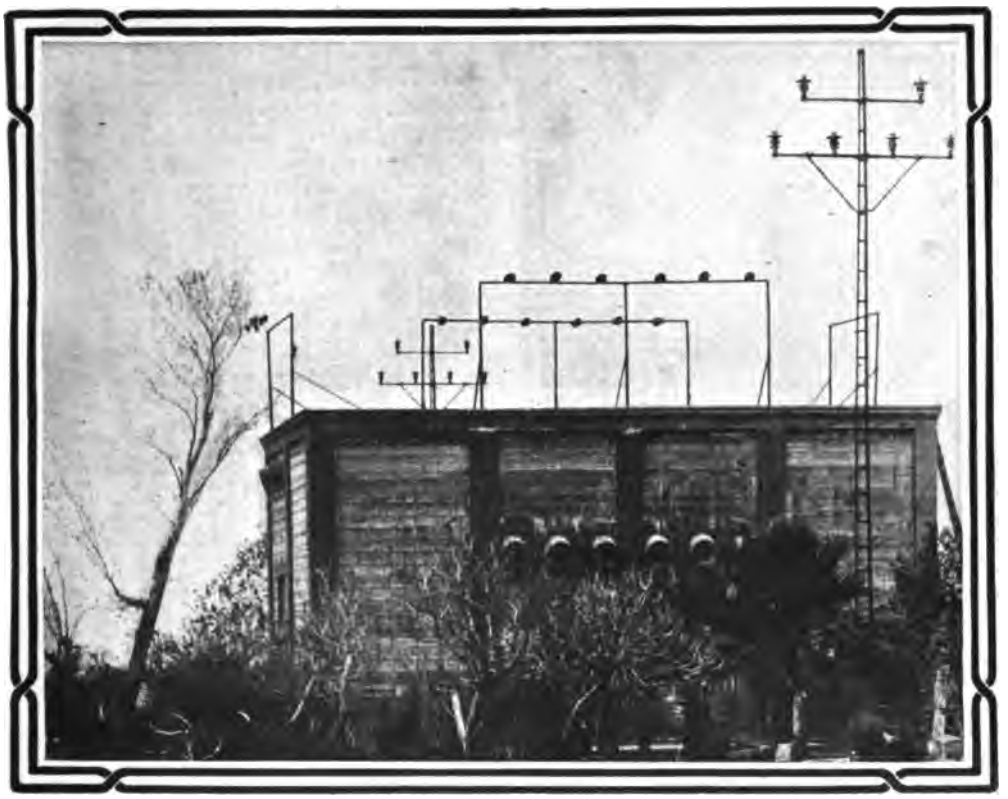
TRANSMITTING ELECTRIC POWER THROUGH THE SALT RIVER VALLEY.

THE ROOSEVELT DAM FROM BELOW, SHOWING ALSO THE POWER HOUSE.

white man; and for the whites their reservation was always a safe refuge against the marauding Apaches. The return they got was wretched enough. But now the Reclamation Service, through the development of power at the Roosevelt Dam, is in a position to restore to these unfortunate people the fruitfulness of their lands; and the Indians—those, at all events, who are left alive—are getting ready to go back to their old farming pursuits.

The works at the Roosevelt Dam, near Phoenix, Arizona, will develop 26,000 horse-power. Part of this will be used to irrigate 50,000 acres which are above the level of the gravity canal, requiring that the water shall be lifted. Another portion of the available energy will be utilized to pump water from wells for the Pima Reservation. In addition, there is a surplus, which has already been leased under contract to light the city of Phoenix; and more power will soon be available, from the same source, for supplying light and power to farmhouses throughout the valley.

Pretty soon the farmers in the valley will enjoy all the advantages which a supply of electricity on tap can furnish. The mere turning of a switch will yield as much of the "juice" as may be requisite not only for illuminating the farm dwelling, but also for cooking, for washing, and for running all the stationary farm machinery, from the feed-cutter in the barn to the churns in the dairy.



RELAY STATION FOR ELECTRIC POWER TRANSMISSION IN THE SALT RIVER VALLEY.

The problem of carrying electricity from the great dam for long distances over an extremely rugged and mountainous country has been one involving many difficulties. The poles that support the wires are of steel, set in solid masses of concrete—severe storms and winds of

hurricane velocity being prevalent in the region at certain seasons. The current transmitted is enormously powerful, and correspondingly dangerous, so that it is found expedient to affix to every pole a warning. Nevertheless, people will persist in climbing the poles, and already there has been loss of life from this cause.

PEOPLE. DESPITE THE DANGER FROM ELECTRICITY. WILL PERSIST IN CLIMBING THESE SKELETON SUPPORTS.

Less easy to provide against is the short-circuiting of the wires by birds, which, especially during the mating season, alight upon them, and, exchanging amatory billings, occasion tremendous mischief—such happenings, in several instances, having blown out fuses and smashed up things generally in the transformer house at the dam. Incidentally, of course, the birds are killed, and in this way several eagles have met electrocution.

On the Minidoka Reclamation Project, in Idaho, works have likewise been established for the production of 30,000 horsepower, part of which will be used for lighting and heating four towns, and incidentally for manufacturing purposes. It is expected that here also the electricity will be furnished to farmers. At the end of ten years, when people have paid for the outfit, under their arrangement with the government, they will themselves own the works and the power, which will be to them a great source of revenue.

In these two instances the government has built power works because the power is needed to lift the water and pour it out over areas which can not be reached by gravity canals. When this has been provided for, however, there is a surplus, which may be turned profitably to account for other purposes. As for the water supplied to the 10,000 acres on the Pima Reservation, by pumping from wells, the Indian Office pays for it, out of a special appropriation made by Congress.

About seventy miles northeast of Phoenix, Arizona, the Salt River runs through a deep narrow gorge. Across this gorge the Roosevelt dam is now ninety-five per cent complete. The dam rises 284 feet above bed rock; is 168 feet thick at the base and twenty feet thick at the crest. The gorge being V-shaped, the dam is only 200 feet long at the base while at the top it is 700 feet, with a 200 foot spillway at each end. This makes the total length 1,100 feet—one of the largest dams in the world. It required 250,000 barrels of cement and 340,000 cubic yards of masonry to complete.

The dam will impound a reservoir with a storage capacity of 1,300,000 acre feet. This means enough water to cover 1,300,000 acres of land one foot deep. That amount of water would cover the entire state of Massachusetts four inches deep and will form a lake with an area of 16,320 acres. About 200,000 acres are to be irrigated directly under the project.

The released waters follow the natural channel of the river for about thirty miles to a diversion dam, 1,100 feet long. This second dam is composed of a system of head gates which divert the flow into large distributing canals. These in turn deliver it into smaller canals, whence it is turned upon the lands to be irrigated.

COL. GEORGE POPE.
Turned his attention from bicycles to automobiles.

GEO. M. STUDEBAKER.
President of the Studebaker Company.

H. H. FRANKLIN.
Formerly manufactured die castings.

MEN WHO HAVE MADE CONSPICUOUS SUCCESSES IN THE MANUFACTURE OF OUR NATIONAL TOY.

OUR BILLION DOLLAR TOY

By

RUBE BOROUGH

UPON the industrial battle-field of America where the Captains of Big Business struggle for control of the means of commercial exploitation a new rival for honors has forced his way to eminence. Born but yesterday, he has nevertheless attained the proportions and powers of a giant and he strides among the dominant figures of the day with the confident hauteur of a world conqueror.

Who is this newcomer in the ranks of the nation's capitalists? He is the maker and seller of a toy,—of the most popular toy of the ages. With a hand of magic he devised that modern sensation and wonder, the automobile, and he proclaimed its merits so effectively that he has swept the nation into a frenzy of buying. So great has been the success attending his efforts that if he should be able during 1910 to meet the demand already made upon him for his product he could truthfully boast a volume of business near to a quarter of a billion dollars. As it looks now, his probable production for the coming twelve months, according to conservative estimate, will reach a total value of around $160,000,000. And for his entire output,—if he lives up to his reputation,—he will get CASH!

That's the striking feature about this spectacularly efficient newcomer,—he has a mania for cash. From infancy he has been cash-fed. And cash as a steady diet has forced a wonderful growth and development.

Let us pause here for a comparison. The typical American Big Business Man has found an outlet for his product through the middleman. He has seldom resorted to direct selling. The final task of distribution he has, in the main, left to an army of retailers. And to these retailers he has almost generally extended credit,—in many lines of business, very liberal credit. In fact in order to reach the ultimate consumer he has often been compelled to put his product into the hands of retailers of limited resources; many of whom he has "carried" continuously on his books. In other words, the resources of the producer have kept the middleman "in the game."

A most striking instance of the liberality of the big producer in dealing with the retailer is seen in the relations of the International Harvester Company to its agents. Here we have a concern cap-

FRANK BRISCOE.
Member of a great motor firm.

WILLIAM E. WRIGHT.
Vice-President and General Manager Knox Auto Company.

BENJAMIN BRISCOE.
President Maxwell Briscoe Motor Company.

PROMINENT MEN CONNECTED WITH WIDELY-KNOWN AUTOMOBILE COMPANIES.

italized at $120,000,000, which in 1909 did a business of $72,000,000 entirely through agents, only a limited portion of whom paid cash for goods. From first-hand knowledge of the field in the Middle West the writer can state that a common method—if not the most common method—of annual settlement between agent and company was the turning over to the company of the ultimate purchasers' — the farmers' — notes, unendorsed by the agent. Thus the fundamental risk of business was transferred from the shoulders of the retailer to the shoulders of the producer of the goods.

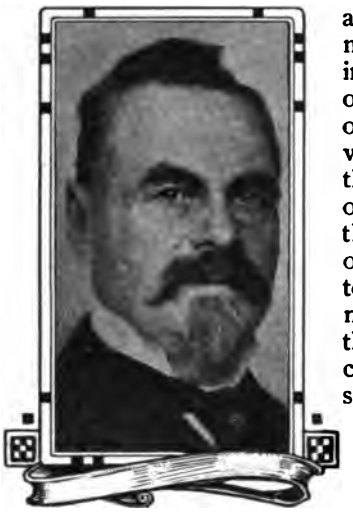
Now the maker of the automobile has pursued the typical American policy in placing his product upon the market through the independent retailer, but he has been guilty of no such cumbersome and costly method as we have just reviewed. He has not "financed" his distributing agencies. As a matter of fact, from the beginning, the distributing agencies have "financed" him. With their contracts for cars the agents have been compelled to surrender a considerable bonus to the manufacturer and to pay in ready money the remainder due when the cars are delivered. The automobile maker has been "getting the cash" and with this cash he has built up his marvelous industry.

F. B. STEARNS.
His financial success in manufacturing automobiles is said to be remarkable.

If we are looking for an explanation of this big turbulent stream of flashing, jingling dollars,—of realized wealth,—that loses itself day by day in the coffers of the motor car builders, we shall, of course, find it in the inadequacy of supply to meet demand. The automobile business for the past two years can be no more accurately described than as a scramble for cars on the part of agents and the general public. Scores of automobile dealers in the Middle West with whom the writer has discussed the subject have emphasized this condition and not a few have declared that they have offered liberal premiums to hasten delivery on cars they had sold. The eagerness of "middle-class" and "upper-class" America to actually possess this newly invented plaything gave the manufacturers the whip-hand,

and being in the position, *they made the terms.*

Back of this quick-sweeping, nation-wide hysteria of demand there is, of course, a reason. Aside from the undeniable appeal that the self-propelled vehicle, *per se,* makes to the popular mind, we are confronted with the appeal of social prestige which its ownership from the beginning implied. For a number of years our comfortable classes have been deluged with a magazine fiction whose main function has seemed to be the establishing of a wide-spread conviction of the intimate relation of spark plug and carbureter to the lives of our social patterns—the idle rich. Our most fetching romances have made excellent free propaganda for the automobile,—the hero's trail of progress has been marked by the smell of gasoline.



THE LATE THOMAS B. JEFFERY.
Founder of the Rambler Works, Kenosha, Wisconsin, said to be the largest in the world.

But our periodicals, monthly and weekly,—in addition, of course, to their strenuous task of "exposing" evil economic conditions and "uplifting" state and national politics—have not only been most liberal in their exploitation, gratis, of the social desirableness of the motor car,—in their voluntary efforts to make this plaything stand before our provincial culture as the symbol, par excellence, of the leisure class,—but today, in the pay of the millionaire manufacturer, they are spreading over the country a volume of straight-forward, hard-hitting advertising unprecedented in the industrial history of the world.

The writer has before him copies for February, 1910, of six of the most widely circulated of the "muck-rake" or "uplift" monthly periodicals and copies for the first week of the same month of our two most widely circulated "muck-rake" or "uplift" weekly periodicals. The advertising of automobiles and automobile parts in these eight magazines constitutes a little over an eighth of the total advertising, with the automobile advertising far in excess of the advertising of any

C. W. MATHESON.
President Matheson Automobile Company.

GEORGE B. SELDEN.
Inventor of the Gasoline Automobile, 1879, now a motor car manufacturer.

R. E. OLDS.
Head of the Reo Motor Company. Father was founder of Olds Auto Co.

CAPTAINS IN THE AUTOMOBILE INDUSTRY.

E. P. THOMAS.
President Thomas Motor Co. Formerly a bicycle manufacturer.

ALEXANDER WINTON.
Engaged in other enterprises besides manufacturing autos.

CHARLES CLYTON.
Treasurer Pierce-Arrow Motor Co. Formerly in the bicycle business.

MOTOR CARS ARE MAKING FORTUNES FOR THESE MANUFACTURERS.

other single article and almost equalling the combined advertising of all the food products appearing in the magazines. If we accept as truth the statement appearing as an advertising bulletin in one of these magazines to the effect that a billion dollars is spent yearly in advertising in this country, we may safely assume that the total advertising of the motor car companies for 1910 will run easily into millions of dollars,—the bigger share of which will go to help finance the "muckrakers." It seems like another instance of the irony of Fate that this latest galaxy of stars in Millionairedom, the motor car manufacturers, should be compelled to seek for their most efficient agents of publicity among a group of periodicals that have gained their tremendous circulations and their influence by a policy of insubordination to the "Powers that be" and by hostile criticism of the system that has created them. Yet such is undeniably the case.

Let us look into the capitalization of this industry. Conservative figures place the present capitalization of those companies turning out merely the finished product at upwards of $175,000,000. With reference to the capitalization of accessory institutions I find the following in *The Motor Age,* a trade journal published in Chicago:

"The Motor Accessory Manufacturers' Association is at present in a particularly healthy condition, with a membership of 174 concerns, representing an aggregate valuation of $307,000,000. There are in the accessory field today approximately 350 possible makers of some standing so that the association numbers but half of the possibilities within its ranks."

From the foregoing it appears to be certain that the entire industry today is capitalized at vastly more than a half billion dollars. This would be three times the capitalization of the farm implement industry as given by the census of 1905, or over four times the capitalization of all the carriage plants and carriage repair shops in the country for the same year.

It may be admitted that the motor accessory institutions have not confined their activities exclusively to the manufacture of parts for motor car companies, that their capital is also involved in some cases in the production of parts or supplies for companies turning out other finished products, such as, for instance, the carriage. But it is undeniably true that even these accessory plants look today for the larger and more profitable

HUGH CHALMERS.
Of the Chalmers Detroit Co.

HENRY B. JOY.
President Packard Motor Car Co.

ELWOOD HAYNES.
President Haynes Automobile Co.

MEN WHO ARE ESTABLISHING THEMSELVES FIRMLY IN THE BUSINESS.

end of their business to the motor car companies and that many of them, flooded with orders for motor car parts, have within the past year or two been gradually severing their business relations with all other manufacturers.

A single industry capitalized at a half billion of dollars, a sum the greater portion of which has been enlisted in a half decade! Surely for rapid development this business is the wonder of our age. The railroads of the nation with their present capitalization of fifteen billions of dollars may offer themselves as a parallel in growth. But these have been building for three quarters of a century and were from the start heavily subsidized with valuable land grants by state and national governments.

The automobile industry, however, has from the beginning, financed itself. The tremendous resources that it marshals today in the commercial struggle it has itself, in the main, created. With its accumulated profits it has purchased and enlarged manufacturing plants, transforming their function from that of a more general production to the specific function of the accessory. And it has erected giant factories for turning out its completed product,—factories covering dozens and even scores of acres of ground. Some illuminating figures as to the accumulation of profits and the multiplying capitalizations of the motor car industry are furnished by the Detroit Board of Commerce in its recently made report on "The Prosperous Ending of 1909."

The reports reads in part: "One of the old companies" (that is, one of the companies engaged in the manufacture of automobiles) "which started in 1904 with $600,000 capital, has made additions to its plant nearly every year since and this year increased its capital to $10,000,000. Another with $1,500,000 capital sold out for $4,500,000, arrangements being made to continue its operations on a much enlarged scale. Another with $227,000 of paid-up capital sold out for nearly four times that amount. Two other Detroit companies have taken over the business of two companies in other cities, one in Hartford, Conn., and one in Cleveland.

"But these expansions of the old companies have been put in the shade by the operations of the General Motors Company" (capital recently increased from $12,500,000 to $60,000,000) "which has bought out half a dozen large plants in Michigan and selected Detroit as the center of its activities. The purchase of fifty acres of land and plans for the erection of buildings to cost $2,500,000 indi-

cate something of the magnitude of its operations."

These buildings, it may be added, if the present program is adhered to, will cover a ground area of nearly forty acres and will have a floor space of nearly one hundred acres. They will constitute the largest establishment of the kind in the world.

Of course, it would be folly to maintain that the expansion of these recapitalizations can be justified alone by accumulations of profit or accretions of fresh capital,—that is, by actual investment. That there is much "water" in the stock of the automobile companies is the commonest assumption of those who are in touch with the men active in this new industry. What has, however,—in addition to the actual investment of accumulated profits,—made these recapitalizations valid is the tremendous earning power of the companies,—the bonanza dividends, in some cases exceeding 300 per cent, which haye been distributed among their share-holders.

As we search through the pages of history we shall look in vain for the records of another industry that has in an equal length of time produced as many men of gigantic fortunes as this automobile industry. It has been the prize millionaire-maker of all time. Within the period of eight to ten years it has whirled men from the obscurity of poverty out upon the glittering stage of Millionairedom. These dazzling transitions are the sensations of the day in the business gossip of the country.

"Detroit folk," says Walter E. Flanders, president and general manager of one of the largest of the automobile companies, "can name many men today millionaires or nearly so who ten years ago were poor machinists earning $3 a day,—and some of them glad to get a steady job even at that. It is a wonderful condition that promotes men so rapidly as that, and not in a mining camp but in an old established community."

But it seems highly improbable that in the future we shall witness any further accession of the newly rich to the ranks of the motor car manufacturers.

"These days," (the days of rapid fortune building), Mr. Flanders goes on to say, "have passed. The industries founded by those same men" (those who achieved sudden wealth) "have grown to such proportions, their factories have become so highly specialized as to equipment, their operations so large, their ability to buy and to economize in a thousand ways are so great that the man who would hope to start today where these pioneers did five or ten years ago in competition with them, faces a hopeless task."

And with illuminating frankness Mr. Flanders states his conviction as to the future of the automobile industry.

"Henceforth," he says, "the history of this industry will be the story of a conflict between giants. Others may be driven from the field and some will join forces for the combat, but only the strongest will survive and maintain their independence."

In other words, the process of centralization has brought the automobile industry to the stage of production on a vast scale. In the future we may expect to see some of the rivals "joining forces" lest singly they be "driven from the field." Consolidation, the trust, monopoly! The General Motors Company with its present capitalization of $60,000,000 may or may not prove to be the entering wedge of trust ownership. But that it has at its command a large and a most awe-inspiring aggregation of resources there can be no doubt.

It would, of course, be impossible to arrive at a final estimate of the cost, direct and indirect, to the nation of this great game of business that has turned out these motor car magnates. We can, however, supply ourselves with some safe and very suggestive figures. Let us put the consumption value of machines to be placed in the hands of the people during 1910 at $160,000,000, a fair estimate. There have been turned out of the factories in the past four years over 250,000 cars. Let us assume that 250,000 cars are in use today, and let us consider the cost of their operation. If these cars will average 5,000 miles of travel a year, they will cost their owners merely for gasoline and lubricating oil consumed and for tires replaced, something over $100 per car, or over $25,000,000 in the aggregate. If we include in our consideration those other big items of expense,

HENRY FORD. WALTER E. FLANDERS. WINSOR T. WHITE.

WELL-KNOWN FACES IN THE AUTOMOBILE WORLD.

—repairs, hiring of chauffeurs, and "boarding out" of cars,—we may safely conclude that the people will spend during 1910 on new cars and on upkeep of old cars upwards of $200,000,000. This vast sum, which is equal to nearly half of the total collected by the railroads annually for passenger fares, is, in the main, a dead mass of non-productive investment. It is spent almost entirely on the motor car as a luxury and a vehicle of "pleasure." It is the price, which in a passion of extravagance, the nation pays for the intoxication of "joy riding."

This is a big country, and a rich one, its total wealth today exceeding $100,000,000,000. But, let it be remembered, this wealth is unevenly distributed. At the beginning of the last decade it was estimated that some 30,000 of our citizens, with fortunes listed at from $500,000 upwards, held title to over one-half of our total resources. And in the last twenty years the process of wealth centralization has unquestionably gone on unchecked. The big fortunes have enormously increased in size while the smaller middle-class holdings, increasing moderately if at all on the average, have sunk year by year into greater comparative insignificance. What does all this mean? It means just this,—that the consumptive capacity of our average citizen is far less than our spread-eagle orators would have us believe it is. Coming back specifically to our subject, it means that our people cannot long continue to absorb 150,000 to 175,000 motor cars in a single year,—as they will during 1910,—without serious depletion of their small investments,—*such, for instance, as they have made in homes,*—or a big curtailing of their annual purchases of the necessities and conveniences of modern life.

This conclusion is given excellent support by the statements of tradesmen with whom the writer has talked in hundreds of small towns in the Middle West. If these tradesmen are to be believed, (and many of them will name you names and give you figures in telling their stories) the real estate mortgage has already played a nice little running accompaniment to the frenzy of buying into which the people have been swept. "People mortgage their homes in order to buy automobiles," is a remark that has been made to the writer again and again during the past year.

And the complaint is quite frequently made by retailers of certain articles commonly regarded as luxuries that the sale of this new plaything has proved detrimental to their business. "The automobile," said a piano dealer of a small town recently, "is the stiffest competitor we have in our dealings with the farmers. Usually the woman of the house wants

THOMAS HENDERSON. A. S. RIKER. HENRY SOUTHER.

MEN OF PROMINENCE IN THE AUTOMOBILE INDUSTRY.

the piano for the benefit of the children but the man too often holds out for the automobile and in spite of our arguments has his way."

And of course the automobile industry has struck a direct blow at the carriage business. Our well-to-do classes have, for the time, at least, forsaken the stylish equipage for the touring car, the limousine, etc. Those Eastern manufacturers formerly engaged exclusively in the production of high-class carriages have in some instances cheapened the quality of their output in order to meet the competition of the Middle Western states,—in other instances, have withdrawn from the carriage business to employ their capital in the building of bodies for automobiles. That the consumption of horse-drawn vehicles has been seriously crippled is revealed by conditions in Michigan, the leading carriage-producing state in the nation, where over 50 per cent of the concerns operating in 1905 are either already out of business or are preparing to close out during the present year. Vehicle builders left producing are reported to be optimistic this year over the prospects of their immediate future, but this optimism results from the knowledge that 1910 will witness fewer rivals in a restricted field and not from a belief that the total consumption of vehicles will be increased.

There is much speculation today as to whether the price of the motor car will remain where it is. Many predict that the day of overproduction is not far off, that we shall before long see automobiles a drug on the market and the price cut almost in two. People point back to the bicycle and declare that motor car manufacturers will be as anxious to dispose of their product as were the makers of the two-wheeled pleasure vehicle,—that they will strike out on a desperate hunt for buyers, that when the realization comes that the number of consumers is limited, competition will loosen up the terms and hammer down the closing figures of a bargain. To those, however, who are closely following the development of the motor car business such a culmination seems hardly probable. Organization, consolidation of forces, is incessantly at work in this new industry. With the passing of the ownership and control of accessory plants turning out the more essential parts into the hands of the big makers, the competition of the small producer,—who is merely an assembler of parts,—will become nominal, only, and may be entirely wiped out in case of any sudden slump in the demand. The "Powers that be" will regulate the supply to meet the capacity of the public to consume. Thus the price of the product will remain where it is, enabling the motor car magnate to continue to reap bonanza dividends just as he did formerly, based on his "expanded" capitalizations.

TO GET WELL AT HOME

By

F. G. MOORHEAD

THE state of Iowa has hired a preacher for the past four years to do nothing but travel around and tell the people to stay at home, work little, eat plenty of raw eggs and not worry. It has organized the most extensive "Cheer Up" system ever perfected. It urges every citizen to wear the smile "that won't come off" and to take no heed of a possible tomorrow of suffering, misery and death.

Now and then this preacher takes a flying trip to other parts of the country: Colorado, New Mexico, Texas and similarly famous health resorts. Every time he returns more firmly convinced of the merit of the work he is carrying on and more eloquent in his exhortations to do little, breathe plenty of fresh air and eat plenty of wholesome food. Last summer he visited Colorado Springs and El Paso and came face to face with the hectic-cheeked exiles from home who wearily asked him for the latest word from loved ones and dolorously coughed their way down the street, shunned of all the native-born.

"Don't, don't let them continue to come out here for treatment and tc die of homesickness," urged town after town. "It's the separation from home and loved ones that is killing them, rather than the consumption. It's the breaking up of established habits, the tearing of life out by the very roots that is making the cheek redder and the cough more racking. Three-fifths of those who come here as 'lungers' go back home as corpses. While they keep soul and body together their life is miserable. We can't take them into our homes, they are 'unclean.' They are strangers in a strange land, exiles if there ever were any. They live apart until finally the homesickness and the change do the work and the fight is over. If you have any of the milk of human kindness left in your body keep your white plague victims at home where they can either be cured or can die in comfort. We don't want them and can do nothing for them."

This is what Iowa, more than any other state in the Union, has set itself to do: to keep its tuberculosis-infected citizens at home and cure them. That is why it induced one of the most practical and eloquent of its preachers to resign his charge and take up the work of traveling about, week after week, year after year, telling the people how to avoid consumption, how to check it and how to cure it. That is why it has passed a law which allows every one of the ninety-nine counties of the state to build a hospital

IOWA BUSINESS MAN WHO CONDUCTS HIS AFFAIRS ON THIS PORCH.
Here he spends his days and nights.

IN THE MEN'S WARD AT A COUNTY TUBERCULOSIS HOSPITAL.

where consumptives may be cared for and where they will secure every bit as efficacious treatment as though they left their homes and followed the westering sun in search of health.

"It is rather remarkable that a state should have to hire a man to advise its people to stay at home, not work much and eat plenty," says Dr. A. E. Kepford, the "reformed" preacher who is now the lecturer of the Iowa state board of control for the department of education on tuberculosis. "It is even more remarkable that the doctrine which I carry around should be received by the people in amazement. They are literally from Missouri when it comes to being told that tuberculosis can be checked and cured right here at home, without the expense of a long trip to Colorado or New Mexico or Texas. But once they become convinced the eagerness with which they enter on the campaign is notable.

"Take the case, for instance, of one of the leading business men of Boone. He heard my lecture and decided to try the home treatment; but he wanted to go to the state sanatorium to see exactly how it was done. When he returned home he built an open-air sleeping room over the kitchen of his house and there he is to be found today directing his business affairs by telephone, dominating the situation as thoroughly as though he were down town, and building himself back to perfect health. This man never arises until after noon, although he has now regained his normal weight and temperature. He has his telephone placed so that he can transact his business without even raising his head from the pillow. Had this man gone away from home his business would inevitably have suffered and he would, in all probability, have died from homesickness and the breaking of all home ties.

"But the work has its tragic side as well. I was at Dubuque not long ago conducting an extensive educational campaign. The opening lecture was attended by four hundred women of the Women's Federated clubs. Among the visitors present were a father and mother and twelve-year-old boy. The little fellow had his right leg amputated above the knee, the result of tuberculosis. His parents had brought him to me to be examined for a swelling then appearing on the wrist. The history of the case indicated that the tuberculosis was manifesting itself at this point. When they

pressed me for a diagnosis I informed them frankly that in all probability it was tuberculosis. The little fellow looked up at me and said: 'Mister, will I need to lose my hand?' I knew, but could not bear to tell him, that he must lose not only his hand, but his life as well. I had come too late."

The anti-tuberculosis campaign being carried on in Iowa is remarkable in that the keynote is optimism instead of pessimism. The people are not being scared, they are being cheered. Other states have waged spasmodic campaigns and made desultory exhibits of a repulsive and grewsome nature. Iowa has no desire to scare its people unnecessarily. The situation is bad, but it could be worse. Every year 2,000 Iowans die of the dread white plague and 6,000 more become infected, but the situation is not without hope. It is this message of hope which Dr. Kepford is hired by the state to sound from border to border.

"Stay at home, rest, don't worry and lead a clean, upright life; you will check and in time eradicate tuberculosis," he preaches day after day, with hundreds literally hanging on his words. "If the plan I carry to the people is carried out, tuberculosis can be totally eradicated from the state of Iowa in thirty years. It means the quarantining of existing cases, raising strict barriers against the immigration of any persons suffering from the disease and the living of outdoor, upright lives by those already afflicted. But think of the thousands upon thousands of lives to be saved and the making of a state without a trace of the dread white plague from one end to another.

"An extensive study of tuberculosis has revealed certain strategic facts: first, that tuberculosis is a house disease; second, that tuberculosis is a disease common among those so circumstanced as to make treatment otherwise than at home impossible. It therefore appears that some method must be devised which will make a sanatorium of a bedroom, porch, tent, or shack, and will place the patient under control and treatment in his own house or dooryard. This can be done only by the most intelligent co-operation of the patient and the members of his household with the physician in charge. The curability of tuberculosis in its earlier stages is well established, many instances being recorded where patients have taken treatment and recovered at their own homes. And many reasons suggest favorable consideration of the home treatment for tuberculosis, chief among which is the fact that the patient is not compelled to be separated from his family and so will not need to combat that peculiar mental disease which often is the cause of serious difficulty in treat-

IN THE WOMEN'S WARD.

ment in a distant country—homesickness. "You have tuberculosis. How you contracted it you may not know, but your physician has established a positive diagnosis. You want to get well, but cannot leave your home to place yourself in a sanatorium where treatment could be taken. What are you to do? You have a choice. You can either remain at home and die or remain at home and perhaps recover. In any event it will all depend on you. Many a person has recovered by taking treatment in his own bedroom, or on the roof of his own house, or on the porch, or in a tent in his own dooryard. You want to take the chance; then do it today.

"Fresh air is the great factor in the treatment of tuberculosis. You cannot recover without it and you must have it twenty-four hours every day. Tuberculosis being a house disease you must find your relief either by inviting into your house the fresh air, or by yourself moving out into the open air. Should circumstances make your treatment within a room necessary, carpets, lace curtains and tapestries should be removed, as they may make your room less sanitary and become covered with infection and dust. The windows should be at once removed and heavy canvas curtains should replace them. These curtains should never be drawn unless to exclude storm or rain. If this proves impossible of arrangement, then your bed should be placed beside the open windows.

THE LEADER IN A "CHEER-UP" CAMPAIGN. Dr. A. E. Kepford, the preacher who advises consumptives to stay at home.

"Better than the open window is the screened porch. The porch may be on any side of the house, but an east or south front is preferable. Your bed is then placed on the porch and this becomes your sleeping apartment.

"Another method which may be employed is the tent. The tent, however, must be properly ventilated, having openings possible on all sides with large vents in the top for the escape of foul air.

"But an ideal way to take the open-air cure is, where practicable, to build a shack in the front or back yard. The shack is constructed of rough lumber with special reference to the treatment of tuberculosis. The floor is raised several feet from the ground and all sides are boarded up at least three feet above the floor. The roof is supported on eight-foot posts, affording ample protection against rain or storm. The sides are canvas, capable of being opened at will to let in the largest amount of sunshine and air.

"Tuberculosis is a disease of malnutrition, attacking the underfed. Its treatment naturally suggests a building up of lowered vitality. This can be done only by the use of large quantities of food. The food must be of the highest quality, plain, substantial, and abundant, and taken from five to seven times a day. Dr. W. A. Evans, of Chicago, says the best of meat, eggs, milk, bread and butter, with vegetables, juices, and fresh fruits to maintain a balance are required. The feeding often has to be forced, as

one may have no appetite, or if there be an appetite it may be variable and erratic. So important is this matter that the most exact and regular habits must be established with reference to it. The tuberculosis patient on home treatment must always bear in mind that because he is taking his treatment at home he assumes a tremendous responsibility unmitigated by the beneficent influence of the supervision of a sanatorium. He is the custodian of his own program and on his intelligent, loyal conduct in his own behalf his cure depends.

"Your recovery will depend largely on temperament. The cure must be earned and it will require an extended period of time to do this. There is small chance for you if you are a melancholy, discontented, fault-finding person. Intelligent, persistent, and painstaking action is required, in which a cheerful, contented demeanor must be maintained. There will always be much to encourage the faithful and the patient with an equable temperament, and fine conduct will find ultimate and large reward."

In order to bring about the millennium which Dr. Kepford predicts, when tuberculosis shall be totally eradicated, the state of Iowa is doing what it can by the establishment of state and county hospitals. A state sanatorium for the treatment of tuberculosis was opened February 1, 1908. At the end of the first six months 105 patients had been received and treated, and sixty had been discharged, one completely cured, 41 improved and 14 unimproved. The ratio has been bettered since then, while scores have visited the sanatorium, learned the method of treatment and returned home to their sleeping porches, tents and shacks to take the cure by themselves. The method of treatment at the sanatorium is simple. It consists of the maximum of rest, fresh air, and sunshine, as well as nourishing diet of which fresh eggs and milk form the chief features. For specific treatment a course of tuberculin is given. When marked improvement in the patient's condition warrants he is asked to perform certain duties about the sanatorium as a part of the treatment; if eight hours' work per day can be performed for three months with no perceptible rise of temperature his improvement is considered permanent and he is returned home.

It is of interest to note that outdoor occupations have supplied their full share of the sanatorium patients. Farmers and farm hands comprised 17 of the 49 men admitted in the first six months. Fresh air is not all that is necessary; there must be wholesome food in right quantities, rest, freedom from worry, and right living. Among the women, housekeepers predominate, 37 of the 56 admitted in the first six months having that occupation.

But neither Dr. Kepford nor the state sanatorium can regenerate Iowa unaided. To assist them the last legislature passed a law by which it is possible for every one of the 99 counties in the state to build and equip a county hospital for the treatment of consumptives. On petition of 200 resident freeholders the board of supervisors must submit the county hospital proposition to the voters. The proposition calls for the levy of a special tax, not to exceed two mills on the dollar, on the assessed property for a period not to exceed twenty years and the issuance of county bonds for the aggregate amount. It provides, moreover, for the election of seven hospital trustees, three of whom may be women, who shall manage the hospital affairs. The hospital must not cost more than $100,000, but under this amount any sum may be spent to build and equip the building. Treatment shall be given absolutely free to those who cannot afford to pay, while actual expenses are asked of those who have the money. Already a half dozen counties have availed themselves of the right to vote a tax for the county hospitals, while petitions are being circulated with the prospects good for the proposition being voted on in a dozen more counties this fall. Within a half dozen years it is hoped to have half of the 99 counties of Iowa treating tuberculosis-infected patients, supplementing the sleeping porches and tents and shacks of the individual homes and taking the burden off the state sanatorium.

No other state has made such headway. Kansas employs a physician to lecture on the subject, but his talks are technical and not addressed to the laity. Iowa is the only state which employs a layman

A COUNTY TUBERCULOSIS HOSPITAL IN IOWA.
The law permits one such in each of the ninety-nine counties.

to present the subject in layman's terms so that all may understand and profit. Other states have established preventive funds and hospitals. In the last year forty-three states and territorial legislatures have enacted sixty-four laws relative to the dreaded disease. Twenty-eight states have appropriated $4,000,000 to be used toward its suppression. Twenty-seven states now have, or are preparing, institutions for its treatment. Every state east of the Mississippi river, except Illinois, West Virginia, Kentucky, Tennessee, South Carolina and Mississippi, has provided state hospitals for consumptives. Iowa is the first and only state to establish county hospitals; to start a systematic campaign to treat and cure its consumptives at home and not send them away to Colorado Springs, Albuquerque, El Paso and other resorts to hawk and cough their weary way to the grave and die of homesickness aggravating the tuberculosis. It can plead not guilty to the terrific indictment returned by a recent writer, in a parable so strong as to be almost brutal:

"A little mother, not yet twenty-five years old, found herself afflicted with consumption. Her three little girls, once a joy in her life, became a burden to her. It was 'Mamma, Mamma' all day long. The little mother had red spots on her cheeks and a slight dry cough. One day when dragging herself around, forcing her weary body to work, she felt a slight but sharp pain in her chest, her head grew dizzy and suddenly her mouth filled with blood. After the hemorrhage there was no doubt: the little mother was a victim of consumption.

"She wrote to the state board of health and said: 'I am told that consumption in its early stages can be cured by outdoor life, continued rest, and plenty of plain good food. I do not want to die. I want to live and raise my children to make them good citizens. Where can I go to get well?' The reply was: 'The great Christian state of Indiana had not yet risen to the mighty economy of saving the lives of little mothers from consumption. At present, the only place where you can go is a grave. However, the state will care for your children in an orphan asylum after you are dead, and then in a few years a special officer will be paid to find a home for them. But save your life—never.' So the poor little mother died of the preventable and curable disease, the home was broken up and the children were taken to the orphan asylum.

"A big fat hog one morning found he had a pain in his belly. He squealed loudly and the farmer came out of his house to see what was the matter. 'He's got the hog cholery,' said the hired man.

So the farmer telegraphed Secretary Wilson, of the United States Agricultural Department (who said the other day he had 2,000 experts in animal and plant diseases), and the reply was 'Cert.; I'll send you a man right away.' Sure enough the man came. He said he was a D. V. S. and he was, too. He had a government syringe and a bottle of government medicine in his handbag, and he went for the hog. It got well. It wasn't cranky for the government to do this, and it could afford the expense, for the hog could be turned into ham, sausage, lard and bacon.

"Anybody, even a fool, can see it would be cranky for the state to save the life of a little mother, and it could not afford it either.

"Moral: Be a hog and be worth saving."

Iowa has come to believe that human beings are as well worth saving as hogs. It leads the world in bringing hogs to life; it is attempting to lead the world in keeping human beings alive.

AVALANCHE PIONEERS HUGE TUNNEL

By

WILLIAM THORNTON PROSSER

SWEEPING down the side of the Cascade Mountains, in Washington, an avalanche carried to destruction two railway trains, four electric locomotives, part of the little town of Wellington, and one hundred lives. This catastrophe, one of the worst in the history of the Northwest, and unique in the annals of railroading, has served to stimulate interest in a project for the longest tunnel in the world, boring its way beneath the tall Cascades for a distance of thirty-two miles and obliterating a mountain barrier that now divides the state into two widely diverse sections. Such a tunnel would be longer than any three mountain bores now in existence, yet in the belief of engineers it is not impractical—merely a gigantic project.

It was about a year ago that a pamphlet was issued anonymously outlining the plan for the Cascade tunnel. Its reception was not flattering. Newspapers ridiculed it as chimerical, the dream of an hundred years in the future. Authorship of the little booklet was veiled in mystery until in March the avalanche piled in the depths of a canyon its five score dead. Then Brig.-Gen. H. M. Chittenden, United States Engineers, retired, living in Seattle, acknowledged himself as the father of the tunnel idea, and explained why his name had not appeared on the title page of "The Puget Sound and Inland Empire Railway," the name he gave his pamphlet. At the time of its publication General Chittenden, then Colonel Chittenden, was still in the service, and did not wish the engineering staff to be brought into any

THE OLD AND THE PROPOSED NEW ROUTE.
The railway tunnel suggested would be the longest in the world.

WELLINGTON BEFORE THE COMING OF THE AVALANCHE.

possible controversy; also he wished to have the project discussed from all angles without thought of its authorship, eliminating personality.

But after the Wellington snowslide interest in the Chittenden suggestion revived, and instead of ridicule the plan has received serious thought. With such a highway beneath the Cascades a duplication of the Wellington disaster would be impossible, while the saving in railway operating expenses would amount to millions annually, providing, as General Chittenden suggested, that eight or nine railway lines made use of the artery. The tunnel would eliminate a vertical lift of three-fifths of a mile, east-bound on the Northern Pacific, Great Northern and Chicago, Milwaukee & Puget Sound, while the Canadian Pacific would be saved an even mile of vertical ascent. Terrific grades are today the most costly feature of Western railway operation.

Ever since General Isaac I. Stevens, first governor of the territory of Washington, was instructed by the war department to reconnoiter a route for a proposed transcontinental railway, way back in the early fifties, the Cascade range of mountains has been the problem of engineers and has taxed the resources of railway builders and backers. The Northern Pacific, twenty-five years ago, was the first transcontinental railway to climb over the precipitous ridge, negotiating the summit with a "switchback" that was one of

THE WORK OF THE GREAT SNOW SLIDE.

the wonders of the West. The Stampede tunnel was later opened at an elevation of close to 3,000 feet.

Previous to the completion of the Northern Pacific, under the presidency of Henry Villard, the Oregon Railway & Navigation Company had taken advantage of the Columbia River water grade and built along the south bank of that river, meeting the Oregon Short Line, and connecting thus with the Union Pacific at Ogden, Utah. Following the Northern Pacific in the nineties came the Great Northern with its three-mile Cascade tunnel, at an elevation of 3,341 feet, and the Canadian Pacific, crossing the Canadian Cascades, known as the Selkirks, at an elevation of a mile and a half.

The Great Northern's Cascade tunnel is the longest and costliest bore in the West. It was drilled by John F. Stevens, then chief engineer of the Hill line, and later chief engineer of the Panama Canal. So accurately was the engineering and construction work carried forward that the crews drilling from the two sides of the mountains met midway with less than an inch difference in grade.

But the ascent to this tunnel is up a two per cent grade, winding in a great letter "S" among the mountain defiles, in one place plunging into the mountainside for the purpose of reversing direction—a tunnel become a turntable. From Everett, at tidewater, to Skykomish, the rise is not to exceed 1.25 per cent, but General Chittenden's comprehensive plan goes farther than the construction of the thirty-two mile tunnel, for he has selected routes from Skykomish to Puget Sound with only three-tenths of one per cent gradient.

Between Skykomish, on the western slope, and Leavenworth, on the eastern side of the Cascades, the distance by the present route is fifty-seven miles. With the proposed tunnel this will be shortened twenty-five miles. Where several hours are now required for passenger trains to make the distance between these two points, the time would be reduced to less than an hour, bringing the eastern and western portions of the state into far

THE LARGEST SINGLE FRAGMENT OF A CAR. THAT WAS LEFT.

more intimate touch. The straight line through the mountain between Skykomish and Leavenworth is just thirty-two miles. General Chittenden says that the tunnel might be shortened by seven miles, but he expresses the belief that the entire distance should be included.

Estimating the cost of the bore at slightly more than $1,000,000 a mile—$200 a lineal foot—the total cost of driving the tunnel between Skykomish and Leavenworth is placed at $34,000,000. In spite of the great length, the contention is made that the work of driving the tunnel presents no serious problem to engineers or builders, and that the magnitude of the undertaking justifies the introduction of apparatus which in the long run would mean great economy. Construction would be begun from both ends, and in both directions from two shafts sunk 2,000 feet from valleys above.

Not only would these shafts greatly speed the work of drilling the underground highway, as General Chittenden demonstrates, but they would be needed for ventilation, upon the completion of the tunnel, and would serve as places for the development of electrical power through the fall of water from the streams that cross above the tunnel's path. Short lines of railway built from the mouths of these shafts to connect with the present line of the Great Northern would be self-sustaining through their value in logging operations.

The originator of the long tunnel idea believes that seven or at most eight years would be ample for drilling from portal to portal, an opening sufficient for a double track system permitting the passage of 200 trains a day in each direction. Instead of the work becoming slower as the different crews bored farther and farther into the mountain, he makes the point that time would facilitate rather than retard operations, and estimates that the last year's work would accomplish fully fifty per cent more than the first. The longest stretch of tunnel would lie between the two shafts, a distance of thirteen miles. His figures indicate that the

FIFTY FEET BENEATH THIS SNOW LAY THE BODIES OF ONE HUNDRED PASSENGERS AND TRAIN MEN.

TAKING THE BODY OF AN AVALANCHE VICTIM UP THE MOUNTAIN SIDE TO WELLINGTON.

two other sections would be completed a year in advance of the intermediate section.

In perfecting the plan of ventilation General Chittenden would drill a third shaft midway between the two construction shafts. Air would be drawn down the larger holes and expelled through the central shaft and at both ends of the tunnel. Just above each end of the tunnel is a stream whose waters could be utilized, by shafts, for the development of further electrical energy.

Electrification of the tunnel is an item of cost not included in the figures given, but such an abundance of water power is now going to waste in the Cascades that all the railway lines traversing the Northwest are laying plans for its utilization. According to the retired engineer's plans, the tunnel would be lighted by the block system, with the lights thrown on half a mile in advance of the electric locomotive used as motive power. In addition the walls of the big bore would be made light in color, so the subterranean highway would be a brilliantly illuminated gallery through which passenger coaches would pass with windows open, and without need of their own lights.

At the main shafts of the tunnel, chambers would be opened for the power stations, and the bore would be widened for sidetracks.

General Chittenden, whose literary and scientific works give him a high standing aside from the distinction he has achieved in the United States Engineering Corps, points out that three tunnels in the Alps aggregate one hundred miles in length; another is under consideration sixteen miles from portal to portal. The two longest railway tunnels in the United States are Hoosack tunnel, almost five miles long, and the D., N. W. & P. tunnel, under James Peak, in Colorado, six miles in length. Even a longer tunnel than the proposed Cascade bore is that of the Croton water system, supplying the City of New York. Of course this is not a railway bore, and is scarcely to be put in this class, being only fourteen feet square in cross section, but it never-

MAIL BAGS DUG OUT OF THE SNOW AFTER THE PASSING OF THE AVALANCHE.

theless has the imposing length of thirty-three miles.

As was indicated, the Chittenden plan is far more comprehensive than the opening of the tunnel only. Connecting the principal cities of Puget Sound by lines radiating from the western entrance to the tunnel, his idea is to centralize all traffic in the big bore, following the same plan at the eastern end. On the western slope of the mountains one of these lines would go direct to Seattle, Tacoma and Portland, to the southward. The intermediate line would proceed in a direct route to Everett, where car ferries would transfer traffic across Puget Sound to the Olympic peninsula, which is one of the greatest storehouses of timber left in the Northwest. To the northward the line would reach Bellingham, Vancouver, B. C., and other ports.

On the eastern slope the direct line would cross to Spokane, the northern one to the upper Columbia River district and British Columbia, connecting with the Canadian Pacific, while the southern route would reach the lower Columbia and the Harriman railway systems. All these lines would be on vastly better grades than existing systems encounter, meaning a tremendous saving in operating expenses, and a shorter route to Puget Sound by from one hundred to two hundred miles on two or

A ROTARY SNOW PLOUGH THAT WAS DEMOLISHED.

TAKING OUT THE BODIES.

three of the transcontinental lines.

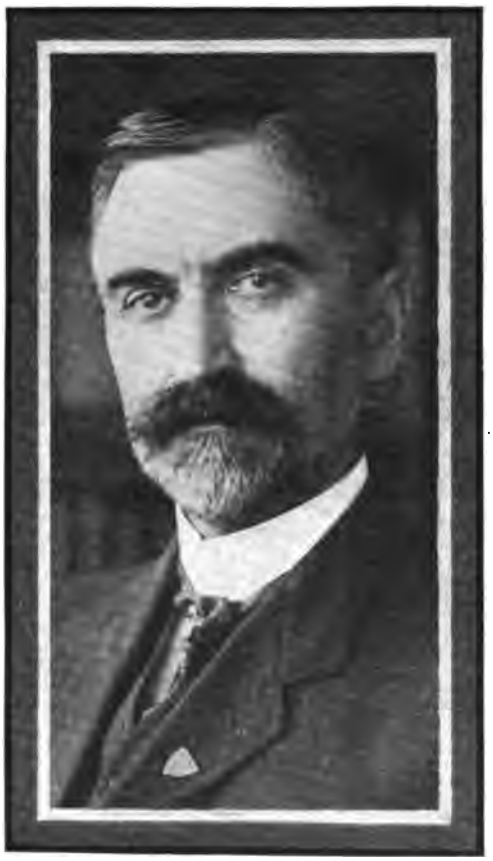
The total length of these railway lines radiating from both ends of the tunnel is placed at 327 miles. General Chittenden estimates construction at $90,000 a mile. It is true that

the recently completed line down the north bank of the Columbia River, cost James J. Hill $100,000 a mile, but material was purchased for this project at a time when prices were at their highest, and the construction in places was rated among the most costly ever attempted in the United States.

Thus $30,000,000 is added to the cost of the enterprise, making a total for the tunnel and its feeders of $64,000,000; including the cost of the electrification of the line the figure placed upon the completed project is $75,000,000.

Then comes the practical question which General Chittenden asks, Would it pay?

Not for a moment is it suggested that one railway bear all the expense of such a huge enterprise. Instead, a joint terminal association could be formed to the advantage of all the lines entering the Northwest. This organization would be similar to the Terminal Railway Company of St. Louis, which owns and operates all the railway lines within the limits of that city. By a pooling arrangement between the Northern Pacific, the Great Northern, the Chicago, Burlington & Quincy, which now reaches Puget Sound over the Northern Pacific's tracks, the Canadian Pacific, the Chicago, Milwaukee & Puget Sound, the Union Pacific, and the mysterious North Coast railways, General Chittenden believes $45,000,000 could be guaranteed.



BRIGADIER-GENERAL H. M. CHITTENDEN, RETIRED, CORPS OF UNITED STATES ENGINEERS.
Projector of the wonderful railroad tunnel.

To open a highway such as the Cascade Tunnel, he believes the state of Washington, assisted by the several counties most benefited, would assist the project to the amount of $15,000,000, and he counts upon an equal assistance from the federal government. Federal aid is becoming constantly more difficult to obtain for internal improvement work, but General Chittenden argues that if the national government will expend large sums for the opening of inland waterways as highways of commerce, the Cascade tunnel would offer itself as an equally meritorious plan.

However, it is argued that the necessary money could be obtained without this item of assistance, considering the fact that Mr. Hill saw his way clear to expend $40,000,000 in the building of the Spokane, Portland & Seattle Railway (the North Bank road), in order to obtain a water grade for the two score million bushels of wheat annually seeking tidewater from the inland empire of Washington. The most powerful argument to bring forth assistance from the Puget Sound country for the Cascade tunnel enterprise lies in the fact that this North Bank line is diverting to Portland and other ports to the southward this great traffic from the interior. Puget Sound's ambition is to extend its commerce, and it will fight to the last ditch to maintain its advantage. But to com-

HERE IN THE WELLINGTON CANYON ONE HUNDRED PERSONS LOST THEIR LIVES.

pete against the North Bank line it must have more favorable approaches from the eastward, across the Cascade range.

Therefore it is plain that the project outlined by General Chittenden is a logical development, and one that must follow before many more years have become history. Puget Sound needs the Cascade tunnel no matter what its cost. And the railways need to reduce to a minimum the cost of their transcontinental haul, for with the completion of the Panama Canal they will be face to face with a water competition that really counts. Today water competition between Atlantic and Pacific ports is a theory.

It is to be regretted that such an appalling loss of life as occurred in the Wellington avalanche should have been necessary to arouse interest in the tunnel project, but perhaps those five score persons did not perish in vain, and eventually the possibility of another such catastrophe will be eliminated by the opening of this artery beneath the danger zone.

Snow blockades in the Cascades through February and March of this year were particularly severe. All the Northern transcontinental lines suffered interruptions, but the Great Northern worst of all. A passenger and a mail train were stalled at the present tunnel for the greater part of a week. The passenger train spent several days just inside the tunnel's mouth, but the passengers feared a snowslide would block the entrance to the bore, and begged the railway authorities to permit the train to move down the track half a mile to Wellington.

Picking out a point that seemed to be least endangered, the train a day before the avalanche took its stand near the little town. Snow plows were working up the mountain on both sides of the tunnel, seeking to open the line and release the blockaded train.

Prompted by an overweaning desire to reach the outside world, and perhaps by a premonition of disaster, several Seattle passengers left the train and made their way down the mountain, over twenty and

thirty feet of snow, to Scenic, a pleasure resort; thence twelve miles to Skykomish, whence the track was open to Everett and Seattle. The news that the train and its occupants had been wiped out reached them ere they could make their homes.

Almost noiseless in its death-dealing progress, the great mass of snow and ice, with tree trunks, stumps and boulders, swept down the mountain side, mowing a path half a mile wide. The passenger and the mail train with the Great Northern's entire electric motive power equipment, installed within the last few months in the tunnel, were lifted from the trails and carried a city block into the ravine below. The great majority of the sleepers in the coaches—the hour was the early morning—passed at once into their eternal sleep.

When morning dawned, there at the bottom of the ravine lay a mass of snow and debris from fifty to one hundred feet deep, only a small part of the train wreckage being visible on the surface. Several passengers had almost miraculous escapes, but the story of the great majority was told as one after another bodies were dug from the snow and wreckage. It will be late in the spring before all the snow is melted and the total death roll is known. It was two weeks after the avalanche before the Great Northern line was open.

This Wellington disaster stands alone in the history of railroading, for there is no record that an entire train load of people was ever before obliterated in just the same manner. Reference books tell that an avalanche in Switzerland once carried down a stage coach loaded with passengers, but that is the nearest approach; yet the wonder is that not before has there been appalling loss of life in this manner on the Western railways.

RESCUES FROM SUNKEN SUBMARINE

By

J. HARTLEY KNIGHT

THE saving of life in submarines which have got out of gear and rest on the bed of the ocean has long puzzled experts, for the natural difficulties in the way preclude the employment of the naval life-saving devices in use on the surface. Not the least of these difficulties is that arising from the inrushing salt water coming into contact with the stored electrical energy or open terminals and the consequent poisoning of the air by the formation of chlorine gas. Among the most effective life-saving devices now in general use in England is a special form of diving helmet, to which is attached a short jacket of strong waterproof material in front of which, inside, is a pocket containing a combined purifier and oxygen generator, consisting of two small chambers joined in one case. These chambers are charged with a patented substance which, when in contact with the water vapor of the breath, gives off pure oxygen gas and forms a caustic alkali. The alkali then takes up the carbonic acid gas of the respired air, and forms an alkaline carbonate. In this way the same air, purified and reoxygenated, is used over and over again.

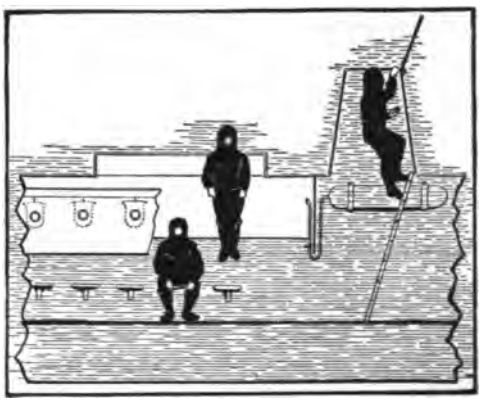
The patent is being worked by Messrs. Siebe, Gorman & Co., Ltd., of London, and has been adopted, after the most stringent tests, by the British Admiralty who have erected at Portsmouth a huge tank, at the bottom of which is a skeleton submarine, where the men are daily trained in the use of the helmet, being lowered to the bottom in an air lock and finding their way to the surface again through the sunken conning tower. These operations are repeated until the officer in charge is satisfied as to the crew's proficiency. A special device is fitted to the apparatus to enable the wearer when he gets to the surface to

inflate a flexible chamber which surrounds the jacket and thus forms a life belt. The necessity of opening the window of the helmet when on the surface to permit of the access of fresh air arises from the fact that the artificial air supply given by the apparatus is limited and some time may elapse before a rescue is effected. The helmet has been used in the thickest smoke and sulphur fumes without affecting the wearer in the slightest degree; and its action is so simple that it is claimed for it that it cannot possibly get out of order.

It must be remembered that water pressure *per se* has no effect on the diver provided that the pressure of air in the device is the same as that of the water outside. The water pouring in will, if the hole is at the top of the boat, gradually replace the whole of the air in the vessel; but if the hole is below the highest point, then the water as it enters will compress the air until the pressure of the latter is equal to that of the water outside. If, now, the men in the boat close up their helmets whilst standing in this reserve of compressed air, the pressure of the air in the helmet will be the same as the water pressure, and the conditions of safety are secure. The crew can now, without difficulty, open the torpedo hatch, or the hatch of the conning tower, and ascend to the surface.

IN THE LIFESAVING SUIT.

Among those who have given special attention to the saving of life in sunken submarines is Mr. G. F. Zimmer, associate member of the (British) Institution of Civil Engineers. This gentleman now offers to the consideration of naval constructors and designers what, in conversation with the present writer, he modestly calls a "suggestion" for an additional means of escape from a sunken submarine. Roughly, Mr. Zimmer's idea is a tube or cylinder, large enough to hold a man, which is attached to the hull of the submarine and through and by means of which the surface of the water can be gained in cases of emergency. Mr. Zimmer does not claim perfection for his plan which he puts forward in the hope that those more expert in such matters than himself may find in it an idea which, if properly developed, may be the means of saving many precious lives. As he remarked, it is not only the men of the British navy who are affected but the men of the navies of the whole world and anything calculated to ameliorate their lot is worth considering.



HOW THE SUBMERGED PERSON WOULD FLOAT TO THE SURFACE.

As sunken submarines do not always lie right way up Mr. Zimmer suggests that three or four tubes should be installed each in a different direction, so that whichever way the boat might be lying one of the tubes would always be upright. He further suggests that the tubes should be attached to the manholes of the hull, thus allowing the crew to escape even if the vessel should be on her side or bottom upwards. In this case provision is made for a valve cover outside each manhole, and escape therefrom is effected by a series of valves and the equalization of pressure of water and air. The success of the scheme as a whole would necessarily depend on the crew's thorough knowledge of the machinery at their command and their readiness and promptitude to take advantage of it.

ABSURDITIES IN OUR POSTAL SERVICE

By

ROBERT FRANKLIN

OUR postal deficit for the last fiscal year was $17,479,000. Why should there be any deficit? The answer is: Mainly because of an obstinate refusal on the part of Congress to utilize the machinery of the rural free delivery system for the carrying of merchandise parcels. If this extension of the service were made, the profits accruing from it would nearly, if not quite, balance the debit and credit on Uncle Sam's postoffice ledger.

There are now 40,000 rural free delivery routes in operation—traversed daily by as many carriers, who serve about 16,000,000 people. These routes have all the equipment requisite for the transportation and delivery of merchandise parcels. Why is it that they do not carry parcels? The answer is that they do carry them, but only a very few, because people cannot afford to pay the postal rate of a cent an ounce, or sixteen cents a pound. Such a rate is practically prohibitive.

Now, the Postoffice Department is anxious to remove this difficulty, and to go into the business of carrying parcels over rural routes, through the adoption of a special rate of five cents a pound and two cents for each additional pound. The government can afford to do the work cheaply, because it already has the machinery and equipment for the purpose, and very little extra expense will be involved. At the rate suggested, it would earn a profit of many millions of dollars per annum.

It is obvious that the adoption of such a plan would be an enormous benefit to the farmers, who could have merchandise of all kinds delivered at their gates—dry goods, groceries, provisions, books, or anything else they might want to buy. The countryman, instead of being obliged to hitch up his horse, and to lose valuable time in making a journey to the village, would be able to send his orders by telephone or post-card, receiving the goods from the daily carrier on his next trip.

The rural free delivery service, of course, is established only in districts where remoteness from other communication with the outside world makes it a necessity. Those who enjoy its benefits have not access to the relatively cheap and convenient methods of transporting packages over short distances which are afforded to city dwellers by the express companies. These companies will not undertake to deliver parcels to people living miles from a railroad, and in most small places they have no offices.

The free rural delivery has improved materially and intellectually the life of great numbers of country people. Is it not obvious that the system should be put to a further use, which, while adding largely to the postal revenues, would directly and vitally benefit every man, woman, and child within reach of a rural route? It would help not only the farmer, but also the village storekeeper, giving to the latter facilities for delivering goods to his patrons such as he does not now possess.

Whatever facilitates consumption and the delivery of goods must increase the business of local merchants and country stores. Such a parcel service would be a boon to the village storekeeper, enabling him to receive his orders by mail or telephone, and to distribute merchandise to his customers through the agency of the rural carriers whose routes radiate from the village postoffice. Thus his sales could

not fail to increase greatly; and this in turn would benefit the jobber by the additional orders transmitted through the commercial traveler.

The advantages of the plan being so manifest, one is surprised to find that it has a great many opponents. Many of the country merchants are themselves opposed to it, on the ground that it would do them harm by helping the great mail order houses in the big cities to distribute their goods. This, on the face of it, seems a plausible idea; but it is wholly erroneous, simply because the scheme is set forth in such a way as to *shut out the city folks* from the privileges of the service. In fact, it shuts out everybody except the local storekeeper and the local customer. Nobody who does not actually reside on a given rural route is to be allowed to send merchandise over that route at the special low rate. The city department store must still pay sixteen cents a pound, as heretofore.

SOMETHING THAT CAN'T BE SENT THROUGH THE MAILS.

Thus it is seen that the suggested parcel-carrying plan is exclusively a local proposition. If this fact were fully realized, it is safe to say that the country merchants would promptly and even eagerly withdraw their opposition and work with all their might and main instead to put such a measure through.

That the express companies are strongly opposed to the plan goes without saying. And, with their enormous capital and widespread business influence, they control great power. But does it not seem strange that the mail order houses should likewise be against it? Unquestionably they are, with entire unanimity. No; it is not at all strange, for these concerns well know that such a rural parcel service would help the country storekeepers enormously, at their expense. Therefore they say nothing. Their policy is to keep quiet on the subject, because, if they showed opposition, it would be rendered obvious that, in their own view, they stood to lose, and not to gain, by cheap local delivery of merchandise packages in agricultural districts.

Thus it appears that the real and substantial obstacle in the way of such a beneficial expansion of the rural free delivery system is nothing more nor less than popular ignorance. The farmers do not realize what a boon it would be to them. The country storekeepers fear it as a source of imaginary danger. Even the commercial travelers, who ought to be better informed, commonly entertain the same delusion, and, themselves always in dread of the rivalry of the mail order houses, encourage the fears of the rural merchants they visit. Consequently, though the Postoffice Department is anxious to adopt the plan, Congress is reluctant to authorize it. As a rule, Congress does not act unless in response to pressure by the people; and in this case very little pressure is being brought to bear, simply for the reason that the people generally do not understand the matter.

Opponents of the scheme say that the great department stores in the cities would manage to utilize the parcel post on rural routes, through local agents, to the great disadvantage of the country merchants, first assembling their orders, and then dispatching the goods in large quantities by express or freight to suitable distributing points.

But the measure before Congress, which was introduced in the Senate by Henry Burnham, of New Hamp-

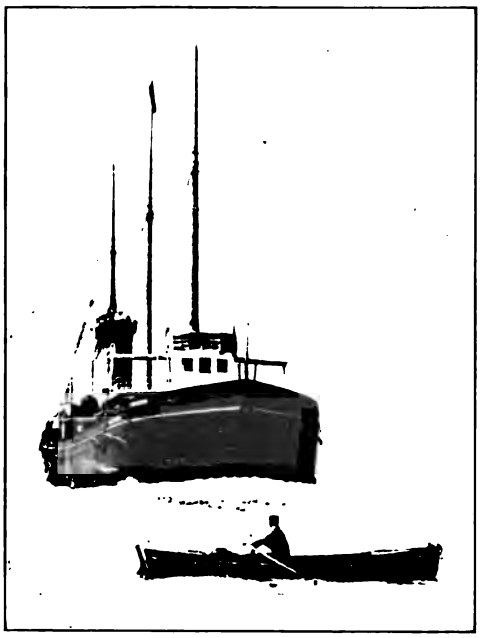
shire, prescribes that no parcel shall be accepted at the special low rate from anybody acting as agent or representative of a person or firm outside of the rural route over which the merchandise is to be carried. If the package is mailed by a merchant, he must be a bona fide dealer whose regular place of business is located on the route. In other words, as already stated, the cheap rate is exclusively for local people, and cannot be granted to an outsider.

The proposed rate for small-sized parcels is one cent for two ounces or less, two cents for four ounces, three cents for eight ounces, and four cents for twelve ounces. It is further required that the words "Rural Parcel Post" shall be plainly stamped on each package. The latter must in no case exceed eleven pounds in weight, and must not be more than three and a half feet long. This limit, it will be noticed, permits the delivery of articles of very considerable size by the rural carrier at the various houses along his route.

Under the proposed plan, the rural resident is at liberty not only to receive parcels, but also to send them at the special cheap rate—so long as they are not addressed to any place outside the limits of the route on which he resides. It is prescribed, as an incidental regulation, that perishable food articles shall not be accepted by postmasters or carriers more than three hours before the departure of mail, and must then be marked, "At the Sender's Risk."

It was said a few moments ago that the regular postal rate for merchandise, sixteen cents a pound, is practically prohibitive, so far as the carrying of parcels on rural routes is concerned. How far this is true may be judged from the fact that, as shown by the figures of the Postoffice Department, the average rural postwagon, in its daily twenty-four miles course, visiting over 100 families, delivers only

OUR TRAVELING POSTAL SERVICE—SORTING THE MAIL IN THE MAIL COACH.



DELIVERING MAIL UPON A STEAMSHIP WITH VESSEL AT FULL SPEED.
Awaiting the steamer's approach.

about twenty-five pounds of mail per day. It collects less than one pound. The average rural family posts hardly one merchandise parcel a year. Its total merchandise product, dispatched and received, is less than ten packages a year. The postal revenue from its entire merchandise traffic is less than fifty cents a year. Meanwhile the 4,000,000 families on the rural routes are constantly making trips to the villages and back again, carrying their supplies and their produce at a needless expense, which, if estimated at only fifty cents a week per family, amounts to $100,000,000 per annum.

The local merchandise mailed in one month at seventeen average postoffices in Alabama weighed only sixty-five pounds; at sixteen postoffices in Arkansas only fourteen pounds; at eighteen postoffices in Iowa only 116 pounds; at sixteen postoffices in New Hampshire only twenty-seven pounds; at sixteen postoffices in North Carolina only thirty pounds; at fourteen postoffices in Oregon only one pound; at fourteen postoffices in Montana only one pound, and at fourteen postoffices in Wyoming the same low minimum of only one pound was maintained.

Under present conditions, merchants all over the United States are commonly obliged to use express service for a large part of their shipments, and to pay charges from 300 to 2,000 per cent higher than freight rates. Express charges on many classes of goods average from five to fifteen per cent of the value of the merchandise transported. But the largest mercantile houses are commonly favored by discriminating rates, paying less—which, of course, puts the smaller merchants at a great disadvantage. There is no appeal, however. They must pay whatever the companies see fit to charge. Hence it is that the Adams Express is able to pay eighty per cent a year on the capital actually invested, and in 1907 was in a position to divide a "melon" of $24,000,000 among its stockholders.

Not only do the companies help large dealers in this way, to the disadvantage of small ones, but they discriminate, in the matter of rates, in favor of large towns and against small towns. Of course, this is deadly to the small place and the small dealer. But, even if they dealt squarely with the people, their service would be unsatisfactory. In many small places they have no offices; and even in the great cities their wagons travel over no regular routes, save in a few business districts. Thus, if the city dweller would send a parcel by express, he must go after an express wagon on foot or by telephone. The postman comes to our doors one, two, three, or perhaps four times a day. We have but to substitute a wagon or automobile post for the over-burdened foot post, and, with a perfected system of collection and delivery of parcels, we shall have a postal express ready made, giving first-rate service and equal service to all.

This, however, is a proposition entirely different from that of utilizing the rural route machinery for a local parcels post service. It is a question of making a merchandise rate somewhat less than sixteen cents a pound, in order to enable the people to use the mails freely for the transportation

of packages. This is a scheme (intended, of course, to cover the whole country) which is sure to be vigorously opposed, mainly on the ground that it would help the great department stores in the cities to destroy the business of the country merchants.

There is no intention to discuss here the pros and cons of the argument. But there is something undeniably wrong about the present state of affairs, under which (to cite an illustrative case) an individual entering the postoffice in Chicago with two parcels, each weighing four pounds, is obliged to pay sixty-four cents to send one of them to New York, while for the other package, which is addressed to somebody in a foreign and distant land, he has to pay only forty-eight cents, for the reason that the rates to foreign countries is only twelve cents a pound.

Should the packages weigh four and a half pounds each, the one addressed to the friend in New York would have to be refused by the postmaster, under the regulations, while the one addressed to the foreign land would be promptly forwarded to its destination. It is reasonable to ask whether we ought to stand for a policy which compels our own people to pay four cents a pound more on parcels addressed to persons living in the United States—even then permitting them to send only four pounds—than on packages addressed to persons living in any one of twenty-two foreign countries—which packages may weigh up to eleven pounds.

In European countries there is no express business such as that with which we are familiar. The carrying of parcels is the work of the mails, and laws forbid competition by private concerns. There is no question of the fact that a similar arrangement was originally contemplated by the government of the United States. Indeed, in 1848 Congress to secure full control of the mails as provided for in the constitution, passed a bill, which became a law, making it unlawful for any private express to carry for hire over any post-road, or from any town or place to any other town or place between which the mail was regularly carried, "any letter or packet."

This law is still on the statute books. For a number of years it was enforced, but since then it has been neglected, and the government no longer claims a monopoly in such matters, except in respect to letters, and this monopoly of course it maintains in the strictest manner. Thus it comes about that the profitable short-haul package business is all handled by the express companies just as entirely too frequently all such "plums" are controlled in the United States, while the long haul is left for the Postoffice

A Rural Carrier's Invention for Holding Newspapers and Parcels.
Each pocket represents a home on his route. The device rolls up.

RURAL BOXES AT THE CROSSROADS.

Department to handle at a loss. The weight of the average merchandise parcel sent through the mails is five and a half ounces, and the average distance it travels is 687 miles.

An eight-pound parcel, by reason of its weight, cannot be sent by mail from New York to Boise, Idaho. But a package of that weight can be forwarded by post to Boise from Berlin, from Vienna, from Rome, from London, or from any other place in Europe, for ninety-six cents. The man in New York is obliged to pay $2.20 to send his eight-pound package to Boise by express—that is to say, more than twice as much. Why, it may be asked, should the foreigner get a preferred rate while our unfortunate countrymen are charged a rate that might very well be considered almost prohibitive? Will Americans never get over the habit of tolerating legislation in favor of certain private business interests?

Under the rules of the Universal Postal Union, each country keeps the postage it collects from its own citizens. No country is allowed to make a rate above the maximum fixed by the Union, but any country may reduce its foreign rate to as low a point as it sees fit; that is a matter for itself alone to decide, regardless of all other nations, and international courtesy requires that the prepaid parcel from abroad shall be delivered free in the country of the addressee. This is the reason why it costs only two cents to send a letter from New Zealand to the United States, while the reply must pay five cents. There are other similar illustrations with reference to the transmission of letter mail.

It is owing to the same cause that one can send a package weighing four and a half pounds from Brussels to Chicago for thirty-five cents, while it costs sixty cents to mail a parcel of the same weight from Chicago to Brussels. It costs only thirty-nine cents to send a seven-pound package from Rome to Detroit, while the postage demanded to carry the same package back from Detroit to Rome is eighty-four cents. It costs $1.32 to forward eleven pounds by mail from Baltimore to Berlin, but the same parcel can be shipped back from Berlin to Baltimore

for eighty-one cents—a difference of fifty-one cents in this instance. A hundred similar examples might be as readily quoted.

There are many such absurdities in the postal service. But, relatively speaking, they are of small importance, at least as compared with certain other absurdities, which really may be considered far more vital. The really necessary change demanded, in the opinion of the Postoffice Department, is the extension of the rural free delivery system in such wise as to enable it to carry merchandise packages at a cheap rate. This, however, must be done with a rigid restriction which shall exclude outsiders, rendering the service on each route purely local, and thus protecting the village merchants against the dangerous rivalry of their powerful competitors—whom they regard as constantly threatening their very business existence—the mail order houses in the cities.

HOW THE QUEEN OF ENGLAND TRAVELS

By

WILLIAM THOMAS

WHILE traveling by special train is no longer a privilege enjoyed only by railway magnates, oil kings, and reigning sovereigns, the last-named are probably the most exclusive in the use of their private coaches. For a couple of thousands of dollars you may go tearing across this continent at top speed, but you must not be over-particular as to the sort of coaches that are furnished you. The millionaire in this country may even lend his whole palatial equipment to his private secretary for a honeymoon—as one of the big men of Wall Street did not so long ago—but it would be sacrilege for royalty to have its private trains occupied by other than the royal owner, except it be by scions of some other reigning house.

King Edward's consort, Alexandra, and their daughter Victoria, have recently added to their traveling equipment a new train of more than ordinary magnificence. There is one suite of rooms for the queen and another for the princess royal.

The bodies of the coaches are built of teak, finished with panels of selected Java. The doors at the end of the coaches are embellished with brass mountings and the queen's arms. The arrangement of rooms is as follows: the day salon; the queen's dining room, convertible into a sleeping apartment for the night by the insertion of a portable partition; the dressing room, and two lavatories; a dressing and a sleeping room for the Princess Victoria, and, finally, quarters for attendants. This arrangement provides two complete and separate suites of rooms.

The ornamentation is chiefly of panels, enriched with mouldings and "Carton pierre" figures, and finished in ivory white.

The illumination is by concealed elec-

QUEEN ALEXANDRA'S DAY SALON.

THE ROYAL BEDROOM.

tric lighting. In the attendants' compartment is contained the whole of the mechanism for the control of the lighting, heating and ventilation. A telephone for communicating with every carriage of the train, and of course with each of the royal apartments is here installed.

To deal with the lighting and ventilation, the salon is equipped with a complete electric installation, consisting of two dynamos working in parallel. A system of ventilation, electrically operated, is in use, and worked in conjunction with means for cooling and heating each of the compartments. For the purpose of keeping the temperature under perfect control, an exhaust electric motor and fan have been placed under the carriage body, coupled to the exhaust duct running the full length of the carriage.

Music, When Soft Voices Die

Music, when soft voices die,
Vibrates in the memory;
Odors, when sweet violets sicken,
Live within the sense they quicken.

Rose leaves, when the rose is dead,
Are heapt for the belovèd bed;
And so thy thoughts when thou art gone
Love itself shall slumber on.

—SHELLEY.

A FEW BILLIONS IN PEAT

By

G. R. MARCHAND

A VAST stretch of desolate waste—miles upon miles of sullen bog, not even attractive as affording a habitat or a refuge for wild life. Yet beneath the surface of this silent morass lies untold latent power — energy — wealth. The swamp is a peat bog and there are nearly eight million acres of such landscape in the United States underlain with peat to an average depth of nine feet.

But what of peat? A substance to which we may be compelled some day to resort for a fuel, as they do in Ireland, where wood for burning is prohibitive in cost, coal is beyond the common folk and petroleum and gas, of course, available only for the rich. If this is the idea, a statement of the manifold virtues and capabilities of peat will be somewhat astonishing. The Irish hand method of digging and drying out peat for domestic fuel is not, it is true, a matter over which to show marked enthusiasm; but in connection with modern invention and engineering, peat resources assume a different aspect.

Experiments of the United States Geological Survey have confirmed foreign tests showing peat to be even superior to many good bituminous coals for operating the gas engine, that coming power-giant of modern industry. More recent work has shown that where peat contains slightly over one per cent of nitrogen the value of the ammonia obtained as a by-product, will more than pay the expense of extracting the gas, leaving the latter as a clear profit. Many American peats run two and some above three per cent of nitrogen. To burn in the good old Irish way, peat must be carefully dried, but in improved gas producers peat with forty per cent of water can be used with success. This greatly simplifies and cheapens the necessary preparation.

The states containing the greatest amount of peat available for use are the New England States, New York, New Jersey, parts of Virginia, North and South Carolina, Georgia, Florida, Ohio, Indiana, Illinois, Iowa, Michigan, Wisconsin, Minnesota, and the eastern Dakotas. Many of these states have no coal and in them peat is destined in a large measure to take its place. Peat, as a matter of fact, is a sort of incipient coal. Left a few million more years and it would in reality become coal; but in the wise dispensation of Providence it seems more than a coincidence that in no portion of the United States is there any considerable overlapping of the peaty areas into the workable coal fields.

MACHINE WHICH PRESSES FIFTY TONS OF PEAT A DAY.

Professor Fernald, of the Geological Survey, in charge of gas-producer tests, returned some time ago from a European trip of investigation where he looked into the uses of peat and found the

THIS BOG YIELDS TWENTY-FOUR HUNDRED TONS OF PEAT TO THE ACRE.
It is situated near Bancroft, Michigan.

older countries much farther advanced along this line than the United States. Ten million tons are there used annually as fuel. He prophesies that peat will soon be used extensively in this country. "Sweden is dotted with peat deposits," he says, "and its bogs are now being extensively utilized for power purposes. During the last eight years new bogs have been constantly added to the list until bogs producing from 2,000 to 5,000 tons of dry peat for power purposes every year are now found on every hand. The power plants are placed directly in the peat bogs and the electric current transmitted to the surrounding towns and used for manufacturing purposes and also for lighting both the streets and houses."

"I believe the day is near at hand," says Professor Davis, also connected with the peat investigations of the Geological Survey, "when American cities located near the peat bogs and away from the coal fields will obtain their power and light from peat. As a sign of the times it may be stated that work will begin in Florida on a plant for generating electric power by producer-gas engines using air-dried peat as a fuel, the power to be transmitted to Jacksonville."

Professor Davis estimates the peat area of the United States at about 7,100,000 acres, with an average depth of nine feet. One acre of peat one foot deep will make 200 tons of dried peat which gives us for a total, in round numbers, thirteen thousand million tons. Converted into machine peat bricks, the commonest method of preparation for fuel, peat is worth three dollars a ton, so that our peat resources have a value of $39,000,000,000, which is more than the value of all the property, live stock, implements and buildings owned by the farmers of the United States.

But peat has a higher mission than to be burned as a crude fuel. It makes incomparable coke, nearly free from sulphur and phosphorus, or the equivalent of hard-wood charcoal and of the utmost value in metallurgical reductions—iron smelting, steel making, copper refining, etc. Reduced to coke, its value would be $10,000,000,000, while the following list of by-products is to be added:

VALUE OF PEAT COKE AND BY-PRODUCTS FROM PEAT DEPOSITS OF THE UNITED STATES.

Peat coke	$10,000,000,000
Illuminating oils / Lubricating oils	4,400,000,000
Paraffin wax	3,400,000,000
Phenol	66,300,000,000
Asphalt	800,000,000
Wood alcohol	7,800,000,000
Acetic acid	2,200,000,000
Ammonium sulphate	2,700,000,000
Combustible gases	6,500,000,000
	$94,100,000,000

Professor Davis states that on the basis of 1.5 per cent of nitrogen in peat, there is stored up in American peat deposits 644,000,000 tons of sulphate of ammonia having a value of $36,000,000,000. Some peats, however, contain over three per cent of nitrogen. Every farmer knows the high fertilizing value of muck, which is in fact a kind of peat. But the extraction of this most valuable of fertilizers through the use of the gas-producer would be only incidental to the production of the 10,310,860,000,000 horse-power hours which the peat would yield, worth at the present price of power, $38,000,000,000.

In Europe great quantities of the more fibrous types of peat are manufactured into stable litter, for bedding live stock, and peat mull, or powder, for absorbent and sanitary uses. Of this class of material it is estimated that there are at least 2,500,000,000 tons available in the United States, or perhaps one-sixth of the total peat deposits. This is superior to straw and other substances now generally used for the purpose and would readily bring $10 per ton, or a total of $25,000,000,000. An Indiana factory now making a peat product of this kind sells its entire output at about twelve dollars a ton.

Peat is being increasingly used in the United States as a fertilizer ingredient, or "filler"; it is an excellent absorbent, especially for the nitrogenous and volatile constituents of the fertilizer. Probably one-half of the total peat supply is suitable for such use. At the prices now obtained this portion represents a value of $38,000,000,000, or approximately double its fuel value.

In Michigan, paper is manufactured from peat, and in Denmark and Sweden ethyl or "grain" alcohol has been produced from it; in Germany it is used to make artificial wood, while fibrous peat, too light for fuel, is finding a constantly growing market for packing, insulation, etc., displacing excelsior, straw, hay and paper.

It is therefore apparent that in the peat beds of the United States, to say nothing of the vast deposits of Alaska, there lies undeveloped and practically untouched an almost incomprehensible amount of raw material from which may be derived fuel, power, fertilizing matter and the materials from which may be made many valuable products, all of which will serve to supplement other resources which are now disappearing or known to be limited in quantity.

OUR PROUDEST ANCIENT RUINS

By

BAILEY MILLARD

The most important find in the way of ancient ruins that has ever been unearthed in America has very recently rewarded the efforts of Dr. J. Walter Fewkes of the Smithsonian Institution. Cliff Dwellings have been found before but never such extensive, remarkable and picturesque houses and palaces. Buildings with from one hundred to two hundred rooms and containing relics of extraordinary interest have been discovered. Perhaps nothing else exists in any country more important or valuable as showing the works of prehistoric man.

THAT grumpy Englishman who complained that America was a disappointment from a traveler's point of view because it had no ruins should now be satisfied. We have ruins, real ancient ruins, and very interesting ones, too, as they tell the story of a race of people that led strange lives and performed strange ceremonial rites. They are down in the little-frequented southwest corner of Colorado and to get to them is a long, hard jaunt over rough trails, but it is likely that in the next few years many tourists will go to see them and seeing, they will wonder.

Built into the side of the cliffs under the Mesa Verde, stand the ancient towns recently explored, excavated and partially restored by Dr. J. Walter Fewkes of the Bureau of Ethnology of the Smithsonian Institution. The old buildings were found some years ago by wandering miners, but it was only the other day that the government decided that they were really the "big thing" that some visiting scientists declared them to be. So now they are being patched up with a view to making of them a permanent show place for people who revel in antiquities and to prevent them from becoming defaced by acts of vandalism such as have already done much to detract from their value. These acts were committed by miners who wanted the old timbers for firewood and other purposes and who lugged off pottery and implements that Dr. Fewkes would have been very glad to secure for the National Museum.

Now there are cliff-dwellings and cliff-dwellings in Southwestern America, but no such proud and extensive ones as those excavated and restored by Dr. Fewkes in the Mesa Verde country. Their location, too, is exceedingly picturesque. The Rio Mancos cuts through this territory from northeast to southwest, forming a cañon one thousand to two thousand feet deep. On both sides of this cañon narrow lateral gorges of like depth and wonderful beauty cut the mesa into shreds, producing successions of huge promontories, sculptured ledges and bold, jagged cliffs. It is on the sides of these gorges that one sees the labyrinth of cliffs and in the high and almost inaccessible recesses are found the long-abandoned homes of the ancient Pueblo Indians. For that the people who lived here in pre-Columbian days were the ancestors of the present races of Pueblos living far to the south there can be no question. They were undoubtedly of the same quiet, agricultural type and had many of the habits and performed many of the religious rites, such as the snake dance and other ceremonies, that the Pueblos have retained for hundreds of years.

The principal and most accessible of the ruins are the Spruce Tree House, located near the head of a draw of the Navajo Cañon, originally containing 130 rooms but now having only 114 rooms and eight kivas or small round apartments in which the medicine was mixed by the priests and the incantations were performed; the Cliff Palace, located east of the Spruce Tree House, a branch of Cliff Cañon, consisting of a group of houses containing about two hundred

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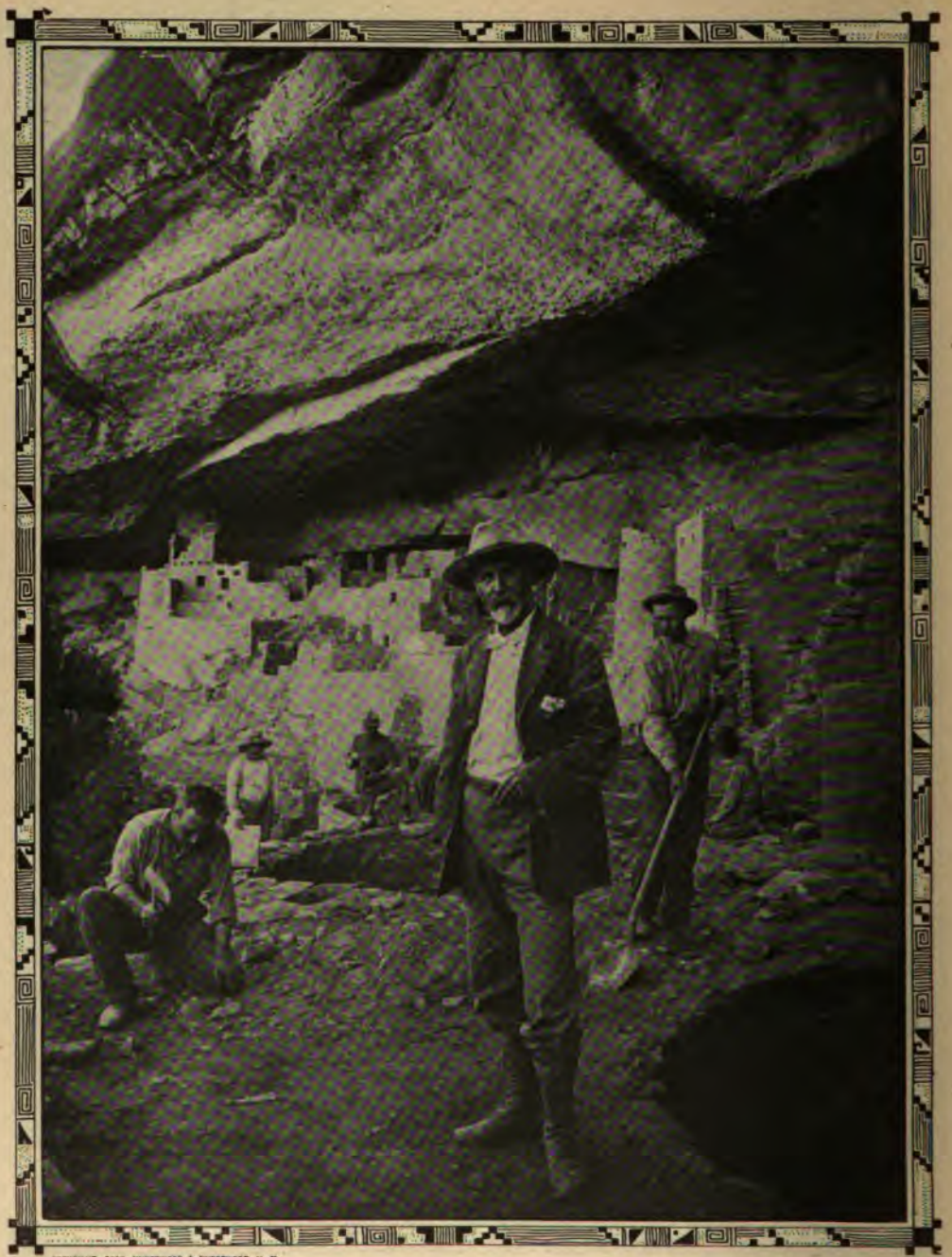
A PALACE OF THE CLIFFS.
This, the largest of the Mesa Verde dwellings, contained about 200 rooms.

rooms, including twenty-three kivas of various shapes, and a tapering, loopholed tower, the houses being erected in a sort of crescent of about one hundred yards from horn to horn; and the Balcony House, also in Cliff Cañon, containing twenty-five rooms, some of which are in most perfect condition. In each of these houses, which are complete villages in themselves is an elaborate system of



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DR. J. WALTER FEWKES, OF THE SMITHSONIAN INSTITUTION, DIRECTING THE WORK OF EXCAVATION AND REPAIR.

fortifications. In some cases there are walls two feet, three inches thick, and twenty feet high, watch-towers thirty feet high and blockhouses with small loopholes from which arrows might be shot down upon the heads of besieging foemen.

The Mesa Verde cliff dwellings also include other important ruins, among them Mug House, Spring House and

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LOOKING THROUGH THE "SPRUCE TREE HOUSE," SECOND IN SIZE OF THE CLIFF DWELLINGS.

Long House, all of which were thoroughly explored by Dr. Fewkes who brought away from them many interesting relics dug from various depths in and about the old buildings.

Dr. Fewkes is the same hard-working, enthusiastic explorer who uncovered the ruins of Casa Grande in Arizona, which, up to the time of this last important excavation, were considered the most impor-

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WHERE NATURE ONCE MORE HAS REASSERTED HER SWAY.
Remains of the Dripping Spring Cliff dwellings.

tant in the country. When I asked him how the Mesa Verde ruins compared with other American building antiquities he replied:

"They are the biggest in this country. There is nothing anywhere near so important on this side of the Mexican line. The crescent-shaped row of buildings that formed the Cliff Palace is perhaps one of the most interesting and

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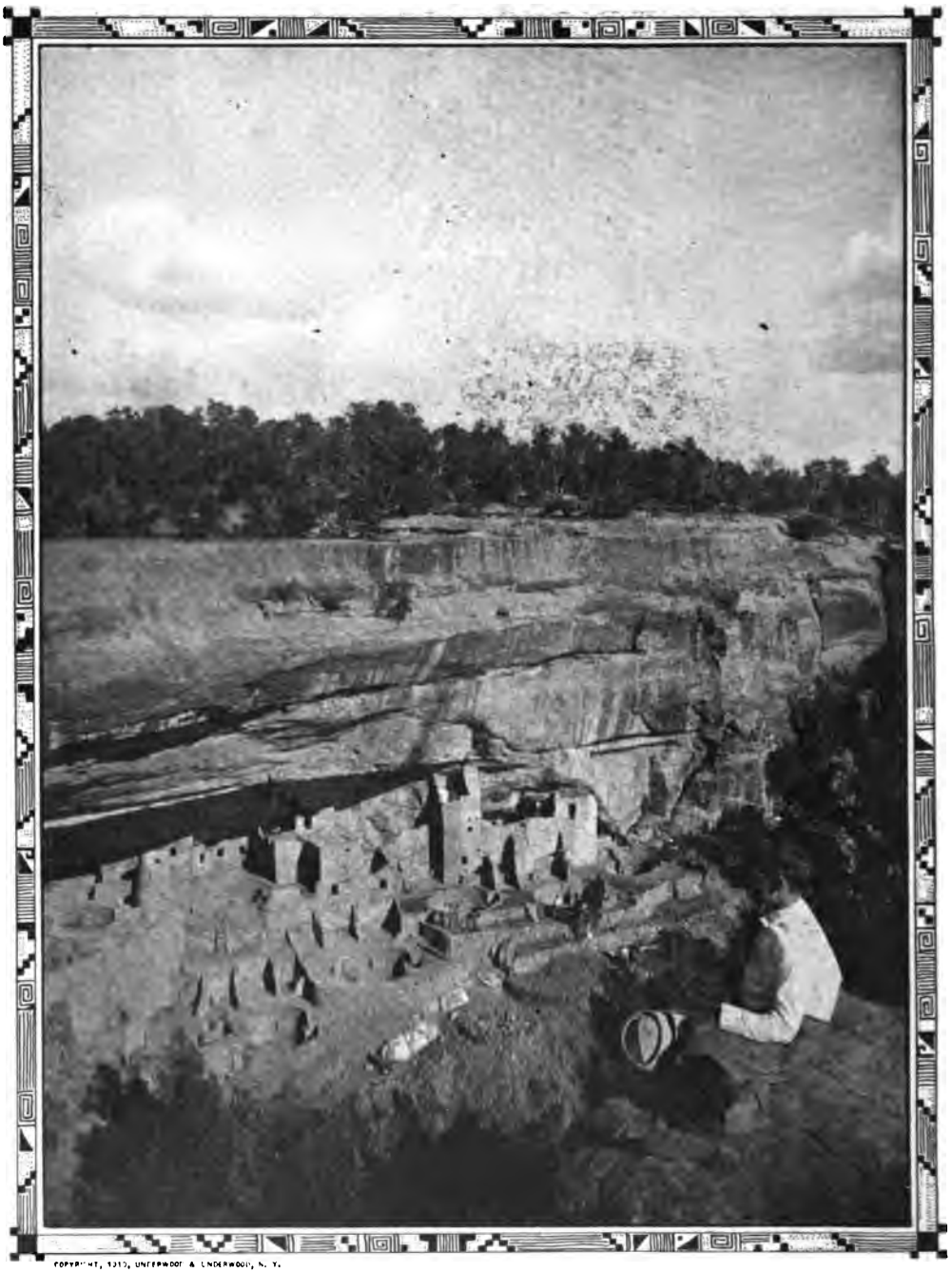
IN THE HEART OF THE CLIFF-DWELLERS' COUNTRY.
One of the Navajo cañons, containing cliff dwellings.

valuable works of prehistoric man now in existence.

"The expense of conducting the excavations and improvements of every kind has been very great because of the lack of a suitable road. All supplies, tools and material have to be transported by means of pack animals at present, but I have recommended that a highway be constructed and this will doubtless be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CLIFF DWELLINGS AS OBSERVED FROM A DISTANCE.

done by the government in time. Then all the world can go and see these truly wonderful ruins."

Dr. Fewkes is a stalwart, clear-eyed man, with a trim, iron-gray beard, and he is still on the right side of sixty. That he is a man of great energy is shown by the fact that he went down into the cañon, where he worked upon the ruins of the Mesa Verde all last summer, by

means of four ladders, descending to the ledge two hundred feet below. He climbed up and down these ladders every day, as he preferred to camp upon the mesa rather than down in the cañon. He had twenty men working with him, chiefly Western miners, and these men required untold quantities of water during the hot days in the cañon. A little burro called Sag carried the water from a spring. Every evening when the men quit work Sag would follow them to the foot of the first ladder and would bray disconsolately all the while they were climbing up the cliff. When they disappeared over the edge of it he would cease his lamentations. He had to be kept down in the cañon as it would have been very inconvenient to conduct him around by the trail.

The work upon the ruins was very hazardous as was the climbing about upon the faces of the cliffs, yet so carefully was it conducted that no one was seriously hurt during the long, hot season of labor among the crumbling, tottering walls.

"When I first saw the Cliff Palace, the most pretentious of the ancient ruins," said Dr. Fewkes to me, "the sight of the work to be done was discouraging. It was difficult to walk around the front of the ruin over the accumulation of fallen stones and debris and it seemed impossible to bring order out of the chaos of broken-down walls. It was hard to tell where to begin work or how to discover foundations of rooms under the mass, but I began at the south end and excavated gradually northward until the terraces and retaining walls of Cliff Palace were brought to light. In the rear of the cave, farther back under the roof of the ledge, the appearance of the rooms was not so discouraging, for here the ruin was in a better state of preservation. In many places however it was dangerous for workmen to excavate, for the buried foundations of sandstone had disintegrated. The work continued steadily and now the ruins, as restored with good mortar and the better class of stone found there, will give one a fine idea of what the Cliff Palace looked like in the days when it served as the habitation of the old tribe."

The discoveries made by the explorer were of marked antiquarian interest. In a walled enclosure at one end of the Cliff Palace was found a number of calcined human bones, together with mortuary objects such as dippers, vases and food bowls. From the smoke upon the roof and the presence of these burnt bones it appears that cremation was practiced by the old inhabitants of the palace. Deep under the debris that covered the lower terrace of Cliff Palace there was brought to light an ancient way which leads by a gradual slope to the center of the village. This main entrance doubtless led to the spring in the cañon below, and along it in ancient times toiled weary women with jars of water upon their heads. Such jars were found in the ruins as well as many other examples of pottery, bowls, vases and mugs, some of them of strikingly handsome design. Eighteen earthen ware vessels rewarded Dr. Fewkes' excavations in Spruce Tree House alone. Some of these vessels bear a rare and beautiful symbolism quite different from that known among the present-day Pueblos of Arizona, though the legends of the modern tribes bear out the speculation that they are the descendants of the cliff-dwellers of the Mesa Verde and other places.

Here, under the Mesa Verde in the olden days, lived a harmless, inoffensive people whose idea was to cultivate little farms on the top of the high mesa and to protect themselves in their almost inaccessible and finely strategic position from the assaults of the wandering Apaches and Navajos, as ferocious then as they were in the days of frontier settlement by white men. Their lives were almost monastic in their exclusiveness. For hundreds of years they did not venture beyond the confines of their mesa and the cañons below it. Their form of government was in a sense monarchical, for they had a ruler known as the Speaker Chief, just as the Pueblos have today, and yet there is a strong probability that communism prevailed in each of the villages. Being very religious they were constantly carrying on some sort of ceremonial, generally of a dramatic nature, such as the snake dance, the priests preparing for these affairs in the subterranean rooms where no one was allowed to come save the anointed.

THE BALCONY HOUSE.
Not yet excavated and in an unsafe condition. Visitors are not allowed here.

Judging from the mummies found in some of the rooms it is apparent that cremation was not invariably practiced. The remains found are generally those of small persons, and it is believed that none was of great stature. They had dainty features, but rather strong limbs, and it is believed that they were the most advanced in culture of all the old American tribes. They made cloth from cotton

grown on their little farms, they cultivated corn which they ground in mills still extant, they made tools and bells of beaten copper and were adepts in the making of pottery. Rarely if ever did they go forth to hunt the rabbits and deer that ranged the cañon. They had no beasts of burden and no animals save the turkey and the dog.

Manifestly there was equality of the sexes on the Mesa Verde. The women and men worked together under the "mother clan" system still in vogue among the Pueblos, and the women owned the secular houses. It is possible that the smallness of the people was due to their living so closely together and their constant intermarriage. Altogether there were probably living in the different villages about five thousand people, eight hundred of whom were domiciled in the Cliff Palace.

And the King of the Cliff-Dwellers, the Speaker Chief who ruled over these people, what sort of a potentate was he? Well, it is indicated in various ways that he owed his position as head of the village to his ability to sway the superstitions of his people by his gift of oratory. In the village known as the Cliff Palace, with its eight hundred people, he lived in the older quarter, inhabited by the most influential clans of the pueblo. The masonry of the Speaker Chief's building is not only the finest in the Cliff Palace collection, but compares well with that laid by white workmen. The foundations are raised above the neighboring buildings and terraces. A castellated portion extends to the roof above the ledge and is three stories high. On the north side the wall of this part is curved, but on the south side there is a platform one step high, and Dr. Fewkes supposes that the Speaker Chief stood upon it every morning when he announced the events of the day. This practice still prevails among the Hopi and other Pueblo Indians. The announcements chiefly related to the rites performed by the men of the tribe, for of these there was almost an endless round.

Taking no part in the religious performances, the women lived only in the secular houses, which they owned. They made the bowls, ground the corn and prepared the food. At times they assisted in building walls, carrying mortar and stones. They were the burden bearers. All of them wore ornaments, some of turquoise, but oftener of polished lignite or bone. The warriors had bows and arrows, stone hatchets, mauls and other weapons. If an attack was made upon them by a hostile tribe their movements were directed by the Speaker Chief.

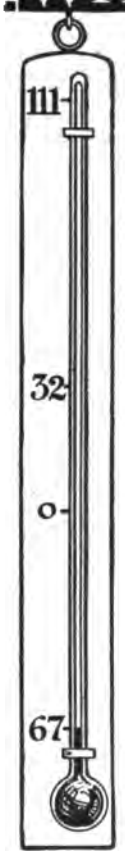
Why did these people desert the Mesa Verde? Well, it is inferred by Dr. Fewkes that there was little cohesion among the cliff-house clans, that there were continual bickerings and many altercations in which the inhabitants took one side or the other, and this ultimately led to the abandonment of the place. One clan after another sought new homes or more congenial neighbors. Finally the last remaining inhabitants left the snug, safe retreat in which they had lived so many years. It is possible that hostiles raided the cornfields on the mesa, thus forcing the inhabitants to seek other abodes, or a contagious disease may have driven them out. In any event the cliff-dwellings were all deserted in the course of time, to become the haunts of eagles, of owls and of chipmunks. The people drifted to the south and their children formed the tribes now known as the Walpi, the Orabai and the Hopi. Today these strange folk, living upon the high, rocky islands of the desert, with their sheer walls in houses through which one enters by the roof, will tell you:

"Formerly our people lived up in the cañons, on the cliff-sides. They came here because they thought it a better land."

As I left the Smithsonian after my interview with the explorer and went up into the Congressional Library to read about the ancient tribes of America, I looked down from the statue-lined upper gallery into the magnificent rotunda, and it came to me that in the year 4,000 after Roosevelt some future Dr. Fewkes and his men might be digging among the ruins of that superb pile. What will they think of it? What will they say of it? Will the proud fact be anywhere manifest that in a hundred years of hurried labor we made more material and spiritual progress than was made in the previous three thousand, during which time whole races and tribes of people, cliff-dwellers, tent-dwellers and dwellers in abodes of all sorts, were virtually standing still?

WHERE EXTREMES MEET

By Harry F Kohr.



IF it happened that you were caught in a blizzard last winter in Chicago, or St. Paul, or even somewhere up in Canada, you might have contented yourself with the thought that you might be worse off in Miles City, Montana. Or perhaps this summer while you are seeking shelter from the blazing sun in St. Louis or Kansas City you can congratulate yourself that you are not in Miles City. For Miles City is a curiosity among American cities, in that there the weather bureau has found the widest range of temperature in the United States. The highest temperature recorded there is 111 degrees, which comes within eight degrees of being the highest ever recorded in the United States, while on one occasion the temperature went down to 67 degrees below zero, a temperature that is seldom felt in Alaska. That is a range in temperature of 178 degrees, which shows the adaptability of human beings to climate, since Miles City is a lively and hustling town. Of course it doesn't get so hot every summer or so cold every winter in Miles City, but when it is hot it is hot in that town and when it is cold it is as cold there as anywhere else.

Other cities which make a good—or bad, as you wish—showing in the temperature line are Poplar River, Montana, 63 below; Great Falls, 59 below; Havre, 55 below; Pembina, North Dakota, 59 below; Bismarck, 46 below; St. Paul, 41 below; North Platte, Nebraska, 35 below; Yankton, 34 below; Omaha, 32 below; St. Joseph, Missouri, 29 below; Oklahoma City, Oklahoma, 26 below; Topeka, Kansas, 25 below; Indianapolis, 25 below; Kansas City and St. Louis, 22 below, and away down in Flagstaff, Arizona, 21 below.

The hottest ever known in the United States was at Phoenix, Arizona, 119 degrees. Yuma has had 118, San Francisco, 114; Walla Walla, 113; Miles City, 111; Fort Buford, North Dakota, 110; Dodge City, Kansas, 108, and Kansas City, 106.

Only one small portion of the United States, the southern tip of Florida, has never experienced freezing weather, although the southern part of California, below San Diego, never has had a temperature lower than 32 degrees. The most equable climate in the United States is found on Tatoosh Island, in the Straits of Juan De Fuca, between Washington and Vancouver Island, where the temperature never has been above 80 and rarely ever below 50 degrees. It would be a great place to live if the rainfall didn't average 113 inches a year.

In general, the temperature of Europe does not vary in the same marked degree as does that of North America. The eastern portion has a less favorable climate than the western. The extremes of temperature are greater, the summers being hotter and the winters colder, while the lines of equal mean temperature decline south as we go east. This difference is due, of course, largely to the influence of the Gulf stream. The farther east we go, the greater the extremes. Peking, in latitude 40 degrees north, has as severe a winter as St. Petersburg, though the latter city is 20 degrees farther north.

HOW THE BASS ARE TAKEN FROM THE BREEDING PONDS.

FISHES HELPED TO BUILD NESTS

By

ROBERT FRANKLIN

THE problem of black bass culture, with which the United States Bureau of Fisheries has been struggling for a number of years, seems at last to be satisfactorily solved. Artificial nests have removed the difficulty.

The black bass is a nest-builder. It makes its nest by cleaning up a circular patch of gravel two or three feet in diameter, in shallow water, and the female lays her eggs thereupon. But experience has shown that if artificial nests are provided in suitably sheltered places, the male fish, which attend to the business of nest-building, will occupy them in preference to constructing nests on their own account.

Various patterns of nests have been tried, but the latest style, which seems much the best, is ingeniously provided with a metal screen, designed to prevent the occupant of one nest from seeing the occupant of another. The male bass attends to the entire work of taking care of the eggs and young, standing guard over them night and day. If another finny parent, similarly occupied, comes within his range of vision, he is disturbed, and may even be seized with a desire to fight.

The black bass is esteemed, "inch for inch and pound for pound, the gamiest fish that swims." Hence it is that anglers in many parts of the United States have appealed to the Fisheries Bureau to propagate the species artificially, and stock new waters and fished-out old waters with the "fry." In Michigan,

which has an immense number of lakes, much profit is derived from the multitude of sportsmen attracted thither by the bass fishing; and, partly on this account, the state authorities have taken up very seriously the business of hatching bass, prosecuting it on a large scale.

Naturally, when such work was first undertaken, the method tried was the same as that adopted for hatching other kinds of fishes—that is to say, to "strip" the females of their eggs, fertilize the latter in the ordinary way, and place them in a continually-flowing current of water, in trays or glass jars. Unfortunately, this plan proved unsuccessful. It was found almost impossible to get the eggs from the mother bass, and the male would not yield his "milt" when it was wanted.

This process was at length abandoned, and resort was had to pond culture, which, in its present state of development, produces most satisfactory results. At Mill Creek, where the Michigan Fish Commission is doing its most important bass work, the ponds are constructed on the model of natural lakes, though of small size, and with certain modifications, presently to be described, for the sake of convenience in the conduct of the pisciCultural operations.

At the center of each pond is a bowl-like excavation, six feet deep, called the "kettle." From the edge of the kettle to the shore, on all sides, the depth is a uniform two feet. Thus, surrounding the central deep water, there is a relatively extensive "terrace" of shallow water. Aquatic plants are allowed to grow profusely all over the bottom, affording shade and opportunity of concealment to the bass, and incidentally encouraging the development of immense numbers of minute crustaceans and insect larvæ, on which the fishes feed.

The brood fish are all wild fish, taken with a hook. Put into the ponds in autumn, they breed in the following spring. They are fed on live minnows, when these are to be had, supplemented at other times by liver cut in long thin strips. The strips are thrown out over the water, a few at a time, with a motion like that used in "skipping" stones. As they strike the water, they have a wriggling

PUTTING UP LIVE BA[illegible] "FRY"—LITTLE FELLOWS—IN CANS FOR TRANSPORTATION.

COLLECTING THE JUVENILE BASS FROM THE NESTS PROVIDED FOR THEM.

motion not unlike that of a worm, and are readily gobbled. The bass will not take the liver in any other way. A too constant diet of it, however, is bad for them, and is liable to result in the death of the eggs.

Just before the spawning season, in March or early April, the ponds are drawn down until the terrace is left bare—the fish, of course, finding their way into the kettle. They are then seined out and sorted (before putting the water back), so that there shall be in each pond about forty males and sixty females. The male and female bass look exactly alike ordinarily, but at breeding time the latter is distended with eggs, so that she is easily distinguishable from the male.

A FINE SPECIMEN OF THE LARGE-MOUTHED BLACK BASS.

Experience has shown that if there be an excess of male fish, they will fight for possession of the females, with the result that many are injured, and some of the nests destroyed. It is said to have sometimes happened that bachelor bass, finding no mates, have gone about from nest to nest in bands, attacking the owners and wrecking the nests themselves. There is no trouble if there is an excess of females; for in that case every male is supplied with at least one mate, and each is too busy caring for nest and young brood to occupy himself much with fighting. Inasmuch as a single male may receive more than one female into his nest, the excess of females does no harm; and it is probable that every female finds an opportunity to lay her eggs.

In order that this may be understood,

WIRE NET CYLINDER TO HOLD FISH READY FOR TRANSPORT.
It hangs through the float, built to hold two such cylinders.

it will be as well to say that the male black bass, in a state of nature, picks out a place for his nest where there is coarse gravel, in shallow water. Standing upright, with a sweeping movement of his tail he brushes away all the sediment from an area two or three feet across. Then, standing on his head, he roots over the gravel; and alternately he roots and sweeps until all the sand and smaller stones are swept to the edge of the nest, leaving only the larger stones at the surface. The removal of material from the center and its accumulation at the border makes the nest saucer-shaped. Incidentally, the stones in the middle are made perfectly clean by the sweeping process, and have the appearance of being polished.

When the nest has been thus prepared, the male stands guard over it, but makes frequent circles into deeper water in search of a female bass. At length he finds her, and fetches her home with him. He remains close by her side while she lays her eggs on the gravel stones; and, if she attempts to run away, he pursues her and brings her back. When she is through spawning, he no longer detains her; and he may even drive her away.

It now devolves upon the male bass to take care of the eggs and "fry." The female takes no part in the subsequent proceedings. He remains over the nest, and guards it until the eggs are hatched and the young bass are ready to leave the nest. Swimming slowly back and forth, he fans the eggs with his pectoral fins and tail, to keep them free from sediment. At frequent intervals he leaves the nest and circles about it, now in this direction and now in that, as if to assure himself that no enemies are near. If another fish approaches, it is attacked and driven away.

When the eggs are hatched, the young bass remain for some days hovering over the nest, and then leave it, accompanied and guarded by the male. Usually they seek very shallow water, along-shore, and the parent swims back and forth in a half circle outside his school. This care is continued until the "fry" are an inch to an inch and a quarter long; then they scatter, and the parent leaves them.

Unless cared for in this way, comparatively few of the bass would live to grow up. Both eggs and young fish have numerous enemies, including various kinds of minnows, sunfish, and young bass of larger growth, which are ready to attack them during even a brief absence of the parent.

The above description applies to the small-mouthed black bass. It is likewise applicable to the breeding habits of the

CAN FOR LITTLE BASS; METAL GAUZE AND PLUNGER FOR SUPPLYING AIR.

large-mouthed species, save in one respect. The female of the latter usually lays her eggs on the fibrous roots of water plants, dead leaves, or other such material on the bottom. Whence it comes about that, for purposes of artificial

propagation, nests are constructed with a bottom of boards, over which a layer of Portland cement is spread. While the cement is still soft, Spanish moss is embedded in it, so as to form a fibrous felt-work over the surface, and on this the eggs are deposited.

When the bass have been sorted out in the manner already described (forty males and sixty females, or in that proportion, for each pond), the artificial nests are placed in position on the terrace, in rows parallel to the shore and extending around the entire pond. Then the water is turned back into the pond, and the fish are depended upon to attend to the rest of the business. It will be understood, of course, that the nests for the small-mouthed species are of gravel—the new style nest being merely an iron ring resting on the bottom and filled with pebbles and sand.

The ring is provided with three slots, to permit the adjustment of a vertical semicircular screen of metal. This screen, as above stated, affords an enjoyable privacy to the parent bass, and prevents him from seeing other nests and other bass near by. Fixed to the top

ARTIFICIAL NEST FOR BLACK BASS, AND "FRY" RETAINER.
The latter should fit into the ring of the nest, but the two objects shown are not photographed on the same scale.

of the screen is an indicator provided with a hand that shows, even when viewed from the shore of the pond, the exact state of affairs in the nest when last examined—that is to say, whether the eggs are hatched or not, or if the

FISHES' EGGS ARE PACKED IN THESE TRAYS FOR SHIPPING.

"fry" are nearly old enough to be removed. Beneath the index hand a white card is set in a frame, with details of the history of that particular nest written out, for close examination.

Now, if the young fish were allowed to leave the nest at the time appointed by nature, and to go off under escort of their parent, they would form a swarm fifteen to thirty feet in diameter, and to capture them with hand-net or seine would be almost impossible, because (as shown by experience) they would run in all directions and disappear among the water plants. Such, at all events, is the case with the small-mouthed species. Hence it is necessary to use a "fry retainer"—a cylinder of fine net with a wooden frame, which, just before the young bass are ready to leave, is set into the metal ring that forms the bottom of the nest.

The bottom of the "retainer" is of net and funnel-shaped, so that the "fry," rising up, pass through the small end of the funnel, and find themselves in the body of the contrivance, from which they cannot escape. It is an easy matter, then, to dump them into a cylindrical can, specially made for the purpose, which is towed behind the boat engaged in the operation. The can is perforated, so as to allow water to pass through it freely, and is suspended through a hole in a

float (shown in an accompanying photograph), being thus almost wholly immersed.

The "fry" of the large-mouthed species, when they leave the nest, remain together in a compact school, and do not scatter and hide when approached with hand-net or seine. Thus it is easy to capture them, and a "retainer" is not needed. They are allowed to depart from the nest with the parent fish, and are taken when wanted.

One reason why the method of culture here described is so interesting is that it takes into view the psychology of the fish. Furthermore, it affords an example of the utilization of natural methods, with up-to-date improvements. Now that the problem of propagating the black bass has been worked out, it proves to be exceedingly simple, and, as a result, all fear of the disappearance of this much-prized game fish may be dismissed. In fact, there seems to be every prospect of its successful introduction in large numbers into many lakes and streams where up to the present time it has been unknown.

TO GROW YOUR OWN MEERSCHAUM

By

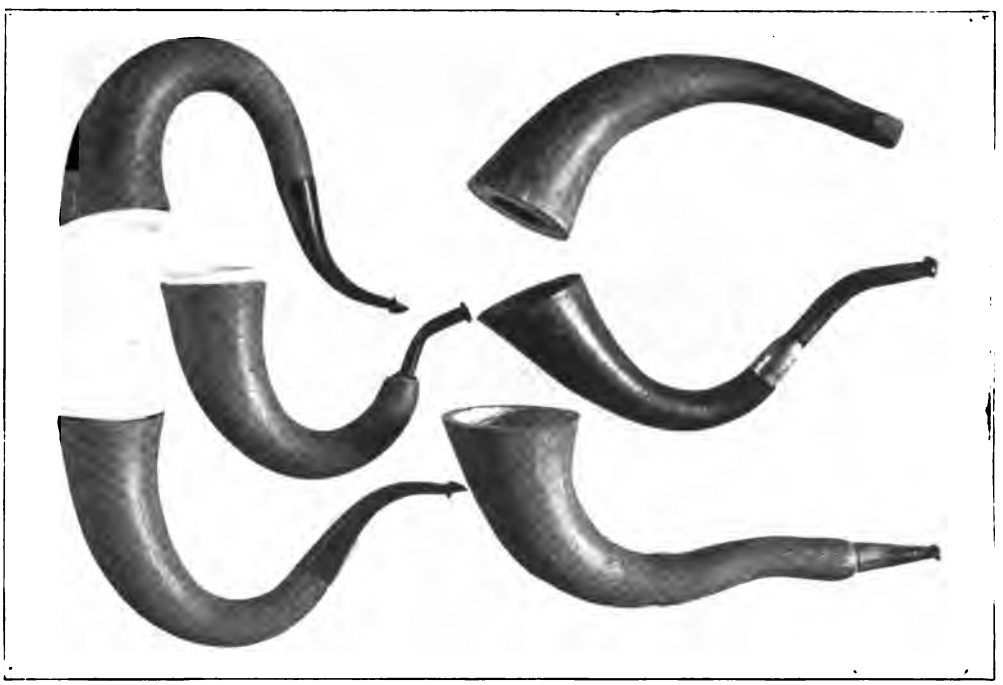
GUY ELLIOTT MITCHELL

CALABASH pipes made from imported South African gourds are the hope of smokers for the future; they have been the fashion in England for some time and are coming into vogue in America. Meerschaum deposits are becoming exhausted, but pipes made from the imported gourds are almost as expensive, and seem to be as satisfactory. American dealers are charging eight dollars to twelve dollars apiece for the simple ones. They are the lightest pipes made for their size, and are graceful in shape, color fully as beautifully as meerschaum and much quicker and are delightful smokers. Unlike pipes which are turned out by machinery, no two of these calabash pipes are alike. In this lies much of their charm, and it is probable that the man who is willing to neglect his family for the coloring of his meerschaum will expend some of his time in growing and shaping a meerschaum gourd and then making it into a pipe. In their individuality, too, lies the cost at the stores of the meerschaum-gourd pipe, for, unlike the great mass of machine-made pipes the crook of the calabash varies so that each mouthpiece must be made to fit it and each lining of meerschaum or plaster of Paris must be specially adapted. Then again, until quite recently the calabash gourds which form the bowls of the pipes have been grown only in South Africa and the supply here has been so limited that they have been treated as novelties and offered to the public at almost prohibitive prices.

MATURE MEERSCHAUM GOURD WITH NATURAL CURVE.

It has been found by experimenters of the Agricultural Department that from New England to the Gulf and from the Atlantic to the Pacific the seed yields the characteristic fruits from which the pipes are made, so that any man may become his own gourd meerschaum pipe

MATERIALS FOR MAKING A PIPF.
Gourd ready for fitting of bowl; plaster of Paris; common meerschaum bowl; machinist's die; curved rubber stem and nipple; extra nipple.



A COLLECTION OF MEERSCHAUM GOURD PIPES.
The three on the left have meerschaum inside bowls.

maker, from the ground up. The vines are luxuriant growers but they should be allowed to trail over the ground rather than on a trellis. The reason for this was discovered the past summer, with plants growing on a six-foot fence.

If the fruits are allowed to lie on the ground they form their crooked necks quite naturally without assistance, and, while not all of them by any means make suitable necks for pipes many of them certainly do. It has been discovered that it is possible to cause these gourds' necks to grow into any desired shape. Provide half-inch boards six by eight inches in size, riddled with quarter-inch holes as close together as they can be bored and five or six pegs for each, which should be about three inches long, whittled to fit the holes, and padded with cloth so that they will not scratch the tender gourd. One of these boards is required for each pipe until its neck is set at the right curve; then it can be removed and used for another. The gourd when still quite young and before its delicate neck has hardened is laid on the board and gently bent in the desired direction and pegged in place. By the following day the tension will be relaxed and the fruit can be still further forced into shape. Three or four resettings of the pegs are usually enough to carry the gourd to the point where the neck is fixed in form.

The meerschaum-gourd vines will thrive in any rich garden soil. Beds of well-rotted manure and mellow loam should be made, as for cucumbers or melons and the seeds planted much as though they were melon seeds, about an inch deep. The vine is a good bearer. Four vigorous plants grown in Maryland in 1908 produced about seventy-five gourds. But it must not be thought that all of the gourds will be fit for pipe-bowls, unless each fruit is found while the neck is still pliable and so tied that it forms the proper curve. Among the large leaves the finding of the very young gourds requires much searching and at frequent intervals. Moreover insects spoil a good many.

The gourds should be left as long as possible on the vines to thicken their shells thoroughly.

YOUNG MEERSCHAUM GOURD. READY TO BE "EDUCATED" TO PIPE SHAPE.

THE MEERSCHAUM GOURD IS A RANK GROWER, AND LENDS ITSELF WELL TO COVERING UNSIGHTLY SURROUNDINGS.

In making a pipe, you must, first, of course, catch your gourd; then the neck end should be cut off and all pith carefully removed from the inside. The thin outside cuticle should be scraped off with a sharp knife before it dries; at least it comes off easier then, and if left on will form food for molds. Powdered pumice is good for polishing the hard surface; sand paper will scratch.

The drying of the gourds seems a simple thing, but there is danger from molds. If stored in a warm, close room for only a few days the cuticle will be covered with unsightly spots, which ruin the hard layer beneath by discoloring it. The necks, after being cleaned and scraped, will cure best if hung up in a cool, dry, but not freezing room where plenty of air is circulating. Postpone the making of the pipe until the gourds are well seasoned. The necessary accessories are a rubber mouth-piece, a bowl, and some thin cork strips, the cost of which should not exceed fifty cents. In addition to these a few cents' worth of plaster of Paris will be needed. Cut off smoothly the tip of the small end and bore through it with a knife blade into the narrow cavity of the neck. Into this screw firmly a crooked rubber mouthpiece with its ivory-threaded nipple. If there is difficulty in getting the hard ivory to cut its own thread, even after soaking the tip of the gourd neck in hot water, a machinist's die, of size according to the thread of the nipple, will cut the thread. The large trumpet-like end of the gourd neck is next cut with a fine saw, at the proper angle and low enough so that a regular cheap meerschaum bowl will fit into it, having its rim flush with the outside of the gourd. A few teaspoonfuls of plaster of Paris mixed with water to form a stiff paste is spread as a thick layer for half-inch inside the rim of the gourd neck. The meerschaum bowl is first greased and then forced into place against the fresh plaster and left just long enough to allow the plaster to set slightly, about three minutes; otherwise it will stick fast.

A FINELY CURVED MEERSCHAUM GOURD PIPE, WITH A PUSH STEM.

The setting for the bowl is now made, but not perfected until a strip of thin cork, such as many cigarettes are tipped with, has been glued smoothly over the surface of the plaster. When properly done—for of course the work has to be done with care—the meerschaum bowl fits snugly, but is easily removed by a twist of the fingers when the pipe is to be cleaned.

REVOLUTION IN GAS-MAKING

By

HENRY J. LORD

FOR many years gas-engineers in all parts of the world have been seeking a means whereby the present costly and wasteful method of gas manufacture could be obviated, or, at least, modified, and some system substituted which should make for efficiency and economical production. What has long been wanted, and has hitherto not been found attainable, is the continuous carbonization of coal in place of the intermittent process now everywhere in vogue.

Through the use of horizontal retorts in gas works a continuous feed of coal and a continuous ejectment of coke have not been possible; but there has now been perfected at the little town of St. Helens, in England, a system of coal gas manufacture—known as the Glover-West system—which is undoubtedly destined to play a very important part in the immediate progress in gas production by its increased efficiency and the reduction of labor costs. Reduced to the utmost brevity the system in question may be described in two words, namely, vertical retorts. The idea of employing vertical retorts in gas production was conceived some years ago, but the difficulty of adapting them for the work was for a long time regarded as insuperable, though their success in the continuous distillation of shale oil in Scotland was always an encouraging factor. Indomitable perseverance and endless experimenting have, however, had their reward, and a system of continuous carbonization has now been evolved—and most thoroughly tried and tested by experts—which in the words of its inventors represents the advanced achievement in simplification, fewness of mechanical parts and, therefore, the minimum for wear and tear and the consequent cost of maintenance.

How infinitely superior is the working of the new system over that of the old was forcibly demonstrated a short time ago when a large company of gas engineers from Manchester went down to St. Helens to see and judge for themselves. No more remarkable contrast could be imagined than was presented by the setting of eight vertical retorts on the Glover-West system, and the ordinary horizontal retorts where numerous workmen were busily engaged in charging with coal and withdrawing the red hot coke, sweltering the while in the great heat from the retorts and frequently rendered invisible by the smoke and the clouds of steam given off as water was poured on the burning coke. "Look here upon this picture and on this," the patentees might well have exclaimed, with Hamlet; for at the vertical setting these conditions were entirely different. There was no noise, no bustle, no undue heat or smoke or steam and to the onlooker the making of gas was apparently the last thing under consideration. Only one man was at work on the eight vertical retorts, and he appeared to have ample time to attend to the auxiliary machinery. Could force of contrast further go?

The patentees of the new system are Mr. Samuel Glover, engineer of St. Helens Corporation Gas Works, and Mr. John West, M. Inst. C. E., a well-known gas engineer and inventor of stoking machinery, of Manchester. These gentlemen freely acknowledge their indebtedness to the late Mr. William Young, whose early practical investigations into the system of continuous carbonization in vertical retorts have been recorded in scientific transactions and in the specifications of the patents that have been granted to him for his inventions in this direction. It was only when the St.

Helens Gas Company was compelled to make an extension to the gas works to meet the increasing demand for gas that the patentees were afforded an opportunity of putting their system to a practical test. The gas committee were induced to allow the installation of the first plant at St. Helens by the fact that they were seriously handicapped for want of ground space, very little of which, of course, is taken up by vertical retorts. The plant has now been in operation a year, and so severe have been the tests imposed by independent experts and so remarkable the results, that the committee have unreservedly purchased it as an addition to their works. The plant in question was complete in every respect and consisted of condensers, exhausters, tar and ammoniacal liquor extractors, purifiers, station-meter, tar and liquor tanks, etc., also a new photometer house for accurately measuring and testing.

THE COKE CHAMBERS AND DISCHARGING DOORS OF THE NEW GAS-MAKING APPARATUS.

The preliminary trials with the plant soon proved the value of the new system of heating. In this system the retorts are heated by separate and distinct combustion chambers—the waste gases being caused to circulate around the chamber at the upper ends of the retorts; while the secondary air is heated by the heat extracted from the spent charge through the walls of the lower ends of the retorts. This system of regeneration is unique in the construction of retort settings, and has been of considerable assistance in enabling the coal to be carbonized with a low percentage of fuel.

The heating chambers begin about five feet from the tops of the retorts, and are continued downwards to within about three feet of the bottom. The hot gases pass completely around the retorts in each of the sections, and then return into one common waste gas chamber; the heated gas ascending upwards and circulating round the top part of the retort on its way to the chimney. At the bottom of the retorts, or—as it is called—the regeneration section, there is another new feature. The secondary air is made to pass round the bottom part of the retort; and the air in so traveling is heated by the hot coke descending the interior of the retort to the coke chamber. Not only is the air thus heated, but the coke at the same time is also cooled.

The retorts are 20 feet long; and the cross section at the top is 24 inches by 12 inches; and at the bottom 30 inches by 18 inches. The lower three feet of retorts is really not carbonizing space, and yet 2½ tons of coal can be passed through each retort in 24 hours. The coal bunkers are capable of containing 24 hours' supply of coal, and are fitted with specially designed coal valves, which are periodically opened when supplying the coal to the coal hoppers in direct connection with the mouthpieces of the retorts. Each retort is fitted with a mechanical coke-discharging apparatus, with adjustable speed gear, which can be timed to regulate the quantity of coke to be discharged through the retort; and, as the coal follows the coke in its descent, the capacity of the retort is in consequence regulated.

The advantage of the vertical system of gas production may be epitomized as follows:—

Increased make of gas per ton of coal carbonized; charging by gravitation; minimum mechanical operation; low fuel consumption; conservation of heat; waste heat of coke utilized for heating secondary air; coke improved and of greater value; cool condition of coke when discharged; high calorific value of gas; low percentage of inert gases; increased yield of tar per ton of coal carbonized; increased production of ammonia per ton of coal carbonized; increased make of

THE SETTING OF EIGHT VERTICAL RETORTS.
Until recently vertical retorts for gas production were thought impracticable.

gas per retort; largely increased make of gas on same ground space; improved labor conditions, and at considerably reduced cost; great economy and saving in first cost of land and buildings; reduced wear and tear on retorts; no naphthalene difficulties; no nuisance from dust, flame, steam, or smoke. Noiseless in action.

When it was decided to hold at St. Helens the meeting, previously referred to, of gas engineers and experts from Manchester, it was arranged that a long and continuous test with two kinds of coal used on these works should be begun to continue up to the date of the meeting.

This test was of thirty days' duration, and with the one setting of eight retorts, one man per shift of eight hours was employed and the cost per ton and per 1,000 cubic feet was as follows:—

	CAPACITY	
	Per Retort.	Per Setting.
Coal carbonized in 24 hours.	2.58 tons	20.7 tons.
Gas made in 24 hours.	29.715 cub. ft.	237.724 cub. ft.
	COST	
	Per Ton	Per 1000 C. Ft.
Wages with three shifts per 24 hours—		
Three stokers at $1.30 per day each = $3.90	$ .19	$ .017
Or if, as in some works, only two shifts were employed, the cost would be, with two shifts per 24 hours—		
Two stokers at $1.30 per day each = $2.60	$ .13	$ .011

The absence of long connecting-pipes between the retort and the gas main, while it may seem a small matter to some, is one of the helpful features of these vertical retorts. As Mr. Glover, in a paper on the subject, points out, the higher make of gas per retort is a very striking feature of the system. The through-put of coal per retort is very greatly increased—thus securing for the future that a very much larger output of gas can be provided on a given ground space, and, in case of new works, with considerable saving of expenditure on land and buildings. By means of these retorts, gas will be manufactured in future under improved conditions of labor, and at a considerably reduced cost. The cleanliness and quietness of the process, the great reduction—in fact, the absence—of arduous manual labor and the simplification of machinery for operating the plant, are advantages of solid value, which will unquestionably appeal to all gas engineers.

RUNNING THE HOME BY ELECTRICITY

By

CHESTER CARTON

IF Santa Claus is as enterprising as he is represented to be he is very busy just about now developing a method of filling stockings without climbing down chimneys, because the electric light companies, electrical engineers, manufacturers of electric specialties and other designing persons with electric axes to grind are doing their honest best to abolish the familiar flues that have so long served the benevolent purposes of the good saint. The house without chimneys has already appeared and its attractions are so alluring that it is likely to be copied extensively.

Where chimneys are there dust and grime and soot and ashes and smoke and coal gas and toil and trouble and soured tempers and appalling bills are also. Any householder would be glad to get rid of these afflictions if he could retain the heat for the sake of which they are endured. That the heat and an almost endless list of other comforts and conveniences can be had without the chimney or any of its accompaniments in any home in which an ordinary electric lighting current is available has been abundantly demonstrated. Indeed, the electrical experts have passed beyond the

WHERE ELECTRICITY HOLDS SWAY.
On the table are an electric flat iron, toast maker, and entree dish.

AT THE CHAFING DISH.

AT THE IRONING BOARD.

stage of showing that electric household appliances will work and are now busy making economy tests to establish their cheapness.

A citizen of Schenectady, New York, without waiting for the importunities of designing salesmen, built a handsome residence in which there was no chimney, furnace, register, radiator, base-burner, gas fixtures or cook stove. By making inquiries of the coal dealer, the contractor and the local electric light company and then doing a few simple sums in arithmetic, he established the fact that electric heating, cooking and lighting appliances could be installed as cheaply as the usual steam heating outfit and coal or gas ranges with their necessary chimneys, and that the cost of operation would be as low, or at least that any small increase would be more than offset by enhanced comfort and convenience. When this model electric house was described to the New York Electric Society the fact was developed that it was by no means the only one of its kind.

Other houses at Schenectady and elsewhere have been heated successfully by electricity, though some of them having been built before the dawn of the electric era may have left over chimneys, steam radiators and other relics of a less advanced age.

In fact tireless inventors have made electricity in the household as handy as the proverbial pocket in a shirt. With an electric outfit housekeeping becomes a delight.

No more need the head of the house vault out of his warm bed barefooted upon a floor cold as ice when the alarm clock sets up its discordant clangor in the gray dawn of a winter morning and stumble shivering down to the murky depths of the cellar to wrestle with the furnace. Instead he has only to set the time switch to throw the current on to the electric heaters at any hour he chooses and take an extra forty winks, knowing that the house will be warm as toast when he gets up at last, even if the wind does happen to be in the north. Neither will he have to torture himself by shaving with ice water because the fire in the range hasn't got down to business: all he needs to do is to turn

A WARMING PAN IN THE BED.

a switch on his electric shaving mug and the water will heat while he is stropping his razor.

Meanwhile his better half is also getting an additional half hour of sleep because she will not have to wait an instant for the fire to burn up. All there is to do to get a light breakfast is to snap the switches on the electric coffee percolator, the electric toaster, the electric cereal boiler, the electric chafing dish, and the electric plate warmer, all of which may stand on the dining room table, where breakfast can be cooked and served piping hot, while she waits for her husband to get done growling because the morning paper hasn't been delivered.

When papa has lighted his cigar at the electric cigar lighter, and has banged the door after him on his way down town by an electric car, she can sweep with an electric sweeper in half the time she used to do it by hand, so that she will be able to make her toilet for the day much earlier than usual with the aid of an electric curling iron heater, and then snuggle down in the cosiest corner of the sitting room in the cheerful glow of the luminous electric radiator, with her slippered feet on an electric foot warmer while she amuses herself doing pyrographic fancy work with an electric needle. Or if she has some sewing to do for the children a tiny electric motor will run the machine for her, leaving her free to concentrate all her attention on her sewing while avoiding the backaches she used to have when she ran the machine by foot power.

AN ELECTRIC SHAVING MUG.

On washing day the electric motor will run the washing machine and the wringer for her; on ironing day she will get through with her task in half the time by using an electric flat iron—there are more than 300,000 electric flat irons in use in the United States today—so that she need not wait a minute for the irons

MASTER LIGHTS HIS CIGAR.

to heat. And when Saturday comes around she can mix the bread with an electrically driven bread mixer and do her baking in an electric oven far better than ever she did it on any other kind of oven, for the electric heat can be regulated to a hair's breadth. She need not be afraid of forgetting the bread when callers drop in unexpectedly because the thermostat will open the circuit automatically when the desired temperature is reached. She cannot even manage to worry for fear the thermostat may not work because she knows a fusible plug will cut off the current in time to prevent disaster if the thermostat does not choose to do its duty.

An electric milk warmer stands ready to serve warm meals at all hours for the youngest, while the rest of the children can amuse themselves with an electric corn popper with no risk of setting the house afire. At dinner time the electric kitchen motor stands ready to grind the coffee, chop the meat or vegetables or raisins, or freeze ice cream when John brings some one home with him from the office. The meal itself can be cooked better than it was ever cooked before, and in less than the usual time with the electric cooking outfit which will stand on the kitchen table. For some reason which bespectacled scientists will presently explain, perhaps, meats roasted in an electric oven are said to have a more delicate and appetizing flavor than those otherwise baked. As a matter of fact everything can be cooked better on an electric outfit than in any other way, for the electric utensils give the same measured amount of heat every

ELECTRICITY IS USEFUL EVEN FOR CURLING HAIR.

time. Thus cooking can be done by the clock instead of by guess. It is all done, too, in a little less than no time. Griddles are ready in three to five minutes, broilers in seven to ten minutes, chafing dishes in five minutes.

A Well-Equipped Dining-Room. Luminous radiator, coffee percolator, and chafing dish are shown.

Electricity on the Dining Table.

Finally when the day is done, and the family once more seeks repose the tired housewife need not warm her icy feet on hubby's back. An electric heating pad, which is a substitute for a hot water bottle, provided with a thermostat which automatically prevents the temperature from becoming too high, will do the job much better and with less danger of divorce proceedings.

And it is all done so economically. In cooking or doing housework by electricity one uses just the amount of current needed and no more. Electric current is sold at so much per kilowatt hour. A kilowatt hour is the consumption of one thousand watts for one hour's time or of one watt for a thousand hours' time. Thus if a device rated at 500 watts is used one hour the consumption is one-half kilowatt hour. A small water heater, for example, is rated at 300 watts. In five minutes it will boil a pint of water. Three hundred watts is three-tenths of a kilowatt and it uses this amount for one-half hour. The consumption then would be one-fourth of a kilowatt hour, which at ten cents per kilowatt hour would amount to one-fourth of a cent.

If the rate happens to be ten cents a kilowatt hour, which is high, the small sum of seven cents invested in electric current will run the washing machine and wringer and do the average week's washing. Twenty-five cents worth of electricity will iron this washing. The same sum will run the porch light three hours every night for a month. Another quarter will run the heating pad three hours a night for two weeks. Still another quarter will broil the matutinal steak on the electric gridiron every morning for

two weeks, or it will make half a score of rarebits in the electric chafing dish or fry two hundred eggs. It has been stated that the average consumption of current for electric cooking purposes for a family of four is eighty-four kilowatt hours per month, which at five cents per kilowatt hour, probably a fair average rate, amounts to $4.20. To get a more correct idea of cost it will be necessary to learn from the local electric light company what the rate per kilowatt hour is, for rates vary in different parts of the country. In Hartford, Conn., where a particularly energetic concern is hustling to inoculate the whole town with the electric habit the rate is six cents per kilowatt hour. Current for a ten candle power low voltage lamp costs a flat rate of ten cents per month in Hartford. In Chicago it is estimated that the average consumption of current is from thirty hundredths to thirty-three hundredths of a kilowatt hour per meal per person. In Carrolton, Illinois, the cost of cooking by electricity for a family of five persons is estimated at an average of $3.50 a month.

A citizen of Sheboygan, Wis., of an inquiring turn of mind made an exact test of the expense of heating an outside room which was not affected by the heating of the rest of the house. The room had an east and north exposure and measured thirteen by fourteen feet, the cubic contents being 1,600 cubic feet. The outside temperature for the month ranged from forty-four degrees above to five degrees below zero, the average

COMPLETE EQUIPMENT FOR THE ELECTRIC KITCHEN.

being 18.2 degrees. The temperature of the room ranged from fifty to sixty degrees. To maintain this temperature required an average consumption of 18.3 kilowatt hours of current per day. To compete with a hard coal heater at Sheboygan prices for coal the experimenter figured that the electric current for heating would have to be sold at one cent per kilowatt hour. But he also concluded that he would rather have the electric heater than the coal at any price.

MAKING TEA.

The same experimenter after keeping careful account of the cost of electric cooking in his own home found the expense of cooking by gas and electricity was the same when the rate for one kilowatt hour was the same as the cost of eighteen cubic feet of gas. In other words, if gas sold at one dollar per thousand cubic feet electricity, to compete with it in cost would have to be sold at two cents per kilowatt hour. But as a practical man he concluded that the convenience and advantages of electric heating devices were such that he would rather pay three cents a kilowatt hour and have the electricity than to get gas at one dollar.

It is not to be supposed that city folk monopolize the luxury of electricity. Any farmer with a small water power or with a gas producer motor, which is little more trouble than water power, can have all the electric conveniences that his city cousin is able to command.

Chauncey W. Broughton employs a twenty-five horsepower gas producer motor with notable success to help him run his six hundred acre farm in De Kalb County, Ill. By an expenditure of two bushels of pea coal per day electric current is furnished which not only lights the house, a tenant house, the barn and barnyard, runs an electro-pneumatic milking machine that milks four cows at once, saws wood, runs a corn elevator, cuts ensilage, runs a threshing machine, a corn sheller and a hay hoist, pumps water for houses and barn and does all the numberless chores around the place, but it also runs the washing machine and wringer and does the churning at the house. The motor generator also charges a storage battery which operates a tramp discourager, which is controlled by a snapswitch at the head of the bed in Mr. Broughton's chamber. This switch operates a burglar alarm circuit connecting the farm house with the tenant house. If it should be necessary to call for help a turn of the switch rings a four inch gong in the tenant house, which would bring some of the hired men in a hurry. Another switch at the head of the bed connects a lamp on an emergency lighting circuit, and this lamp flashing in the eyes of a possible intruder is expected to disconcert him while the help summoned by the gong is arriving, if the necessity should ever arise. There has been no occasion to use the tramp discourager, but its presence gives the women folk a sense of security they never knew before.

Explained

PROF. ROBERT HERRICK of the University of Chicago desired to point out to a young sonneteer the difference between the words "astonish" and "surprise."

"Noah Webster," Prof. Herrick said, "was once caught by his wife in the act of pressing the hand of the pretty cook.

"The cook blushed like a rose, while Mrs. Webster said in a sad, tremulous voice:

"'Why, Noah, I am surprised!'

"But the philologist, looking over his glasses at his wife, answered reprovingly:

"'Madam, you have not studied our glorious language as you should. It's I who am surprised. You are astonished.'"—*Philadelphia Record.*

She Does

CHOLLY—"Your sister treats me like a dog."

MARY—"What! Does she kiss you, too?"—*New York Telegram.*

It Would

THE POTENTATE (to the Grand Vizier, one of whose four-and-twenty wives he wishes to appropriate)—"But, having so many, surely you can spare one?"

THE GRAND VIZIER—"Er, yes—but you see, your Majesty, it's this way: it would break the set."

One for Papa

OLD SKINEM—"Huh! So you want to marry my daughter, eh?"

YOUNG MAN—"Well I guess that's about the size of it."

OLD SKINEM—"Um—yes. Can you support her in the style to which she has been accustomed?"

YOUNG MAN—"I can—but I'm not mean enough to do it."—*Chicago News.*

There are Lots of Others

"HE says his wife is largely responsible for his business success."

"Well, she has certainly made it absolutely necessary for him to earn more money."—*New Yorker.*

Power of Association

MRS. DE TEMPER (looking up from the paper)—"Well, I declare! Another woman, single-handed, has captured a burglar. I should think she would have killed the brute; but the paper says the moment she grabbed a poker and made a dash for him, his knees trembled and his teeth shook, and he sank to the floor in fright."

MR. DE TEMPER—"He is probably a married man."—*N. Y. Weekly.*

Answering It

A BOSTON woman, said Mr. Bliss Carman at a dinner in New York, once asked Lowell to write in her autograph album, and the poet, complying, wrote the line, "What is so rare as a day in June?" Calling at this woman's house a few days later, Lowell idly turned the pages of the album till he came to his own autograph. Beneath it was written in a childish scrawl. "A Chinaman with whiskers."—*Washington Star.*

The Impatient Age

"SO SHE sued him for breach of promise?"

"Yes," answered Miss Cayenne. "I'm afraid the get rich quick spirit is becoming general. People don't seem willing to wait for alimony."—*Washington Star.*

A Narrow Escape

"How many times have you been married?"

"Three, but——"

"Madam," he interrupted. "I'm taking the census, not proposing."—*Detroit Free Press.*

Earned by Bare Feet

"BAREFOOT dancers earn enough to dress richly."

"While modest people almost have to go barefooted."—*Kansas City Times.*

The Henpecked Worm

THE HEN—"Get hout, yer miserable, crawlin', little worm! If yer was 'arf a man yer'd come an' turn the wringer fer yer poor slavin' wife."

THE WORM—"No, Sarah, I may be a worm, but I ain't one wot turns!"—*Sydney Bulletin.*

Hardly Time

"THEY say that when a mountain-climber has a fall all the sins he ever committed flash through his mind. Was that the case with you?"

"Oh, no. You see, I fell from a ledge only a hundred yards high!"—*Fliegende Blaetter.*

No Trouble About That

PA—"But, young man, do you think you can make my little girl happy?"

SUITOR—"Do I? Say, I wish you could 'a seen her when I proposed!"—*Cleveland Leader.*

Exact Obedience

A LADY staying in a hotel was frightened by a noise like that of a person running about in a room over the one she occupied. In "How to be Happy though Civil," the Rev. E. J. Hardy tells the story:

The noise went on at intervals for two nights, and then changed, as if the occupant on the floor above had gone mad and was skipping about. The lady did not believe in ghosts, but she was afraid of them, so she asked the proprietor to investigate the mystery.

It was a sick foreigner obeying the imperfectly understood directions of an English medical man: "Take the medicine two nights running, then skip a night."—*Youth's Companion.*

She Wasn't, However

LITTLE MISS MUFFET was sitting on a tuffet when up came a spider.

"Why," she asked of the daddy-long-legs, "why do you seek me?"

"If I am mistaken, I beg your pardon," replied the spider, "but I thought you were a little fly." And it was this flippant remark that frightened Miss Muffet away.—*Cleveland Plain Dealer.*

A Soft Answer

MRS. STARVEM—"How do you like the chicken soup, Mr. Newbord?"

MR. NEWBORD—"Oh—er—is this chicken soup?"

MRS. STARVEM—"Certainly. How do you like it?"

MR. NEWBORD—"Well—er—it's certainly very tender."—*Catholic Standard and Times.*

They Would Come

A YOUNG woman of a Western town desired to show some kindness to a young officer of the militia to whom she had taken a fancy. She therefore despatched this note,

"Mrs. Smythe requests the pleasure of Captain White's company at a reception on Friday evening."

A prompt reply came which read,

"With the exception of three men who are sick Captain White's company accept your kind invitation and will come with pleasure to your reception Friday evening."—*Cosmopolitan.*

Why Men Turn Gray

INQUISITIVE LADY—"And what is this little box for?"

NERVE-RACKED CLERK—"Oh, for odds and ends."

INQUISITIVE LADY—"But it has two compartments. Why is that?"

NERVE-RACKED CLERK—"One's for odds, madam, and the other for ends."

A Lost Art

"THEY say that a mummy just arrived in New York is that of the cook of Rameses II."

"That so? Well, somebody had the secret of keeping a cook," and the suburbanite sighed wistfully.—*Philadelphia Public Ledger.*

A Scandal

FIRST LADY—"Did you notice Mrs. 'Awkes 'ad a black eye?"

SECOND LADY—"Did I not? And 'er 'usband not out of prison for another week. I don't call it respectable."—*London Opinion.*

A YOUNG COMET HUNTER

By WILLIAM WALES

TWELVE miles out of Madison, Wisconsin, the seat of the state university, lives a farmer's boy, John E. Mellish, who has attracted the attention of Director Comstock of the Washburn Astronomical Observatory, and of Professor E. E. Barnard, of the Yerkes Observatory at Williams Bay. He has

TELESCOPE CONSTRUCTED BY BOY ASTRONOMER.

discovered two comets with telescopes made by himself and these discoveries have been duly accredited to him in astronomy. He has received medals for his work from astronomical societies in this country and in Mexico.

The first telescope made by this boy was comparatively small, a six inch affair. Later he constructed a much larger one, of sixteen inches.

Comet hunting in itself is not so very difficult a matter. Good eye-sight and patience being requisite. An eye-piece of low power with a wide field is far the best for this purpose of comet-detecting. The discovery of all comets is thus accidental. Of course when a new comet comes within range of vision it is carefully studied and the probability of its reappearance in the future calculated by the big astronomers.

It is the habit of Professor Wendell of the Harvard College Astronomical Observatory, just before retiring each night, to make a survey of the heavens in order to see if by chance some new comet has appeared. On several occasions he has been rewarded for this care by the discovery of a comet.

JOHN E. MELLISH, WHO HAS BEEN REWARDED FOR COMET FINDING.

POPULAR · SCIENCE & MECHANICS SUPPLEMENT ·

GREATEST OF ELEPHANT HEADS

THE greatest of elephant heads, far larger than that of the famous Jumbo, and considered the record breaking specimen so far brought into civilization has just been presented to the New York Zoological Park, to form one of the star exhibits of the great national collection of heads and horns, brought together through the enthusiastic efforts of Director W. T. Hornaday. This magnificent trophy was obtained recently in British East Africa, by an expedition sent out under the auspices of the Museum of Natural History, New York. Mr. Richard Tjader, an experienced sportsman and hunter of many lands, was leader of the expedition, the purpose of which was to obtain types of the big animals inhabiting the British East Africa protectorate. The elephant proved to be one of the largest ever killed, measuring twenty-five feet in length and twelve feet high at the shoulders. Around the chest he measured eighteen feet, seven inches; length of the trunk, seven feet, six inches; circumference of one of the front legs, five feet, two inches; length of tusks, seven feet, two inches, and their weight, 186 pounds.

NATIVE BRIDGE WORKERS.
Queer sight to Western eyes, photographed at Khartoum.

A CURIOUS SIGHT

THIS photograph shows a curious and very interesting scene upon the great new bridge now being erected over the Blue Nile, at Khartoum, by one of the bridge companies of England. The bridge will be shortly completed and will be opened probably by the Khedive. Native labor is largely employed and, to western eyes, the effect is odd to see natives employed on steel-work.

ICE-BROKEN BRIDGE

A WINTER of unusual severity in the west froze the ground to a depth of nearly two feet and the ice on the streams to a thickness of from eighteen to twenty-four inches. When the thaw came with a rain that quickly melted off the accumulated snow many streams were overflowed and numerous ice gorges were formed. One of these in the Kaw River at Argentine, Kan., carried away two heavy steel bridges at one time, as shown in the photograph at the bottom of this page. Not a trace of the superstructure of the bridges could be found after the ice had moved out of the river.

NEW GRADIOGRAPH

THE gradiograph is an ingenious instrument of remarkable simplicity, recently designed by A. G. Thornton, of Manchester, which will be of much help in connection with railroad construction, sewering and road making, and in fact for any purpose where it is necessary to work to a gradient, or to ascertain the correct inclination of any existing gradient. The instrument is specially suited for laying pipes in a tunnel or heading, as it warrants exactly the same fall in each individual pipe. No error can possibly occur. Civil engineers and surveyors will also find the instrument of much use for ascertaining the correct gradient of any existing road, sewer or railroad, or for checking any work carried out under their supervision. The picture shows its use in a sewer.

NEW GRADIOGRAPH.
Instrument shows inclination of pipe without elaborate measuring.

NEW BRIDGE WASHED AWAY.
How river structure, near Argentine, Kan., was carried away by the ice and all trace of the superstructures lost.

LIFE-SAVING GUNS

TWO of the most interesting relics in the exhibit of the life-saving service at the Alaska-Yukon Pacific Exposition, held at Seattle, Wash., recently, was the first mortar ever fired in the history of the U. S. life-saving service, together with the original projectile. The old mortar, which is of iron, is mounted upon a metal base, the whole weighing about 150 pounds. Its bore is about five inches in diameter. Unlike the cylindrical projectiles now in use, the original shot was a ball weighing about forty pounds. That the old mortar was wonderfully efficient is attested by a silver plate set into the muzzle, bearing the following inscription: Mortar from which first ball was fired in the U. S. to save life. Projectile was shot across the British ship *Ayrshire,* January 20th, 1850, saving 201 lives. The ball bears an inscription to the same effect. Close by the old equipment stands a modern Lyle Life Saving Gun, a handsome small brass cannon, mounted upon wheels. The new gun is very powerful and can hurl a projectile 1,000 feet with line attached. It has given and is giving fine service far beyond what its predecessor could do.

OLD LIFE-SAVER.
First mortar and shot ever used in the United States life-saving service.

A ONE-MAN LODGE

ONE of the amusing features of a recent fraternity reunion was the "sandwich man," who represented the entire lodge from one city. In his disgust at the lack of interest shown by his fellow members he had the sign-painter inscribe this legend on the "sandwich" which he wore in the parade:

"EVERETT
No. 479
THE OTHERS
STAYED AT HOME."

A ONE-MAN LODGE.
Fraternity parader and the sign he carried in a Western conclave procession.

ENGLISH SEWAGE DISTRIBUTOR

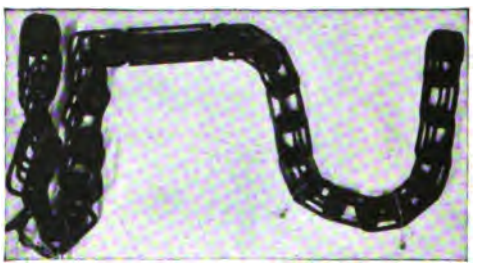
THERE are in operation at Bodmin, England, five filter beds, each fitted with unique revolving sprinklers, as shown in the accompanying illustration. The flow from the sedimentation tank is discharged to these sprinklers, which distribute it for aeration.

CIRCULAR SEWAGE FILTRATION BEDS.
Elaborate construction for sewage disposal at Bodmin, England.

CURIOUS KNIFE-WORK.
Odd designs from single blocks, made by clever whittler.

BOSTON STREET FLOODED

THE picture at the bottom of this page represents one of Boston's principal business thoroughfares after a brief period of activity of a thirty-inch high pressure water main. On a cold evening during the last holidays, when the streets were quite crowded in the shopping district of Boston, a young geyser appeared with the bursting of the water main which sent many yards of paving into the air with a loud report and caused many thousands of shoppers to seek shelter.



MASTERPIECE OF WHITTLING.
Triple link and telescope chain made with a knife from a single piece of wood.

Though the main was shut off in less than ten minutes, Washington street, the principal business street, was flooded to a depth of two feet, causing damage amounting to $200,000. This is probably the most expensive similar water break known, and besides the filling of nearly every department store cellar on the street, four of the principal theatres were forced to suspend performances. Street car service was paralyzed and hundreds of pedestrians were cut off from escape in a minute and forced to seek shelter in stores and restaurants.

A FLOODED BOSTON STREET.
Night scene in Washington street, Boston, during a flood caused by breaking of a 30-inch water-main.

$8,500 FEATHER.
Of course it wasn't one feather, but was fifteen feet of the finest ostrich plumes, put together.

A 250-POUND FEATHER

IT is doubtful if the world ever saw an ostrich plume as magnificent and costly as the one recently exhibited in the streets of Los Angeles as part of a pageant. It represented a value of $8,500 in materials alone, as it was composed of genuine white ostrich plumes of high quality. Its dimensions were fifteen feet long by eight feet wide and its weight was two hundred and fifty pounds, as ten thousand individual plumes went into the making of this gigantic display. Aside from the planning, to make it artistically successful there was a good deal of actual labor required in getting this plume together. It represents four days' work of six people. This unique display was produced by one of the largest ostrich farms in the United States.

USE OF PEA VINES

IN the early history of pea canning, the pea vines were treated as a waste product, the disposal of which involved considerable difficulty and expense. Most commonly they were thrown out in piles to rot, the resulting manure being used for fertilizer. During recent years, the pea vines have risen to the dignity of a

AN ARIZONA BAKERY.
Mexican oven for bread-baking in the open.

by-product, from which the factories derive considerable profit. They are now utilized for silage, or fed to stock in a fresh state, or cured for hay. They make a silage superior in value to corn silage. They may be preserved in silos the same as green corn, or they may be put up in large stacks in the open air. If these stacks are well put up and the vines are well tramped, decay will only affect the surface to the depth of a few inches. The U. S. Department of Agriculture has recently made an extensive investigation of this subject and published the results in a circular. The pea vines can easily be cured by spreading them on sod land. Pea-vine hay is considered better than clover hay. Both the hay and the silage are excellent feeds for dairy cows. They are also satisfactory for horses and sheep.

ELECTRIC CANAL HAULAGE.
Boats on the Erie Canal being towed by motor. Canal motor can be seen at extreme left of picture.

AN ARIZONA BAKERY

TRAVELERS through the Mexican settlements of Arizona will notice mounds of earth about four feet high and shaped something like a bee hive which stand in the back yards near the adobe houses. Close investigation reveals the fact that they are the ovens in which the population bakes its bread, a fire being maintained inside the mud structure until it is thoroughly heated and ready to receive the loaves.

Like many other devices which are apparently primitive, this outdoor oven is precisely adapted to the country in which it is used, as any American housewife knows who has tried to bake bread indoors during the Arizona summers.

FIGHTING FROST

FOR the first time in the history of fruit growing in America, and probably in the world, the fruit growers of Colorado last year successfully accomplished the feat of "heating up all out doors," fighting off not only a "frost" but a regular old fashioned freeze, and produced from the splendid orchards of the western slope of Colorado and in the fruit district about Canon City a crop which totaled a value of almost $7,000,000. And this in face of the fact that on the first and second days of May the mercury at many places touched a point as low as twenty degrees above zero. The growers saved their fruit by burning oil in pots under the trees.

CLOSE VIEW OF MOTOR.
Canal hauling by electricity is becoming recognized as the best and cheapest of all methods.

FIRES SAVE AN ORCHARD.
Actual scene in a western fruit orchard on a night when frost was fought by fires.

DESTRUCTIVE ROSES.
Beautiful growths sometimes wreck the house upon which they climb.

HOUSE MADE FROM ONE LOG.
Hollowed-out tree-trunk used as a room. The white squares are visitors' cards.

MINER'S LAST HOME

THE life story of one of California's pioneers is very simply and beautifully told in the carved marble which marks his resting place. It represents a typical prospector's cabin of logs standing beside a mountain ridge, which is pierced by a tunnel, evidently the mine wherein he sought his fortune. On either side of the door of the little cabin lean the shovel and gun to typify the hard work and the danger of early days in the west. The door is closed as if the pioneer's working days were over. This is the epitaph:

"After a restless life of toil and travel over mountain and streams, he has found a home at last."

STRANGE MEMORIAL.
Tombstone of a miner in a western cemetery.

NOVEL ROOM

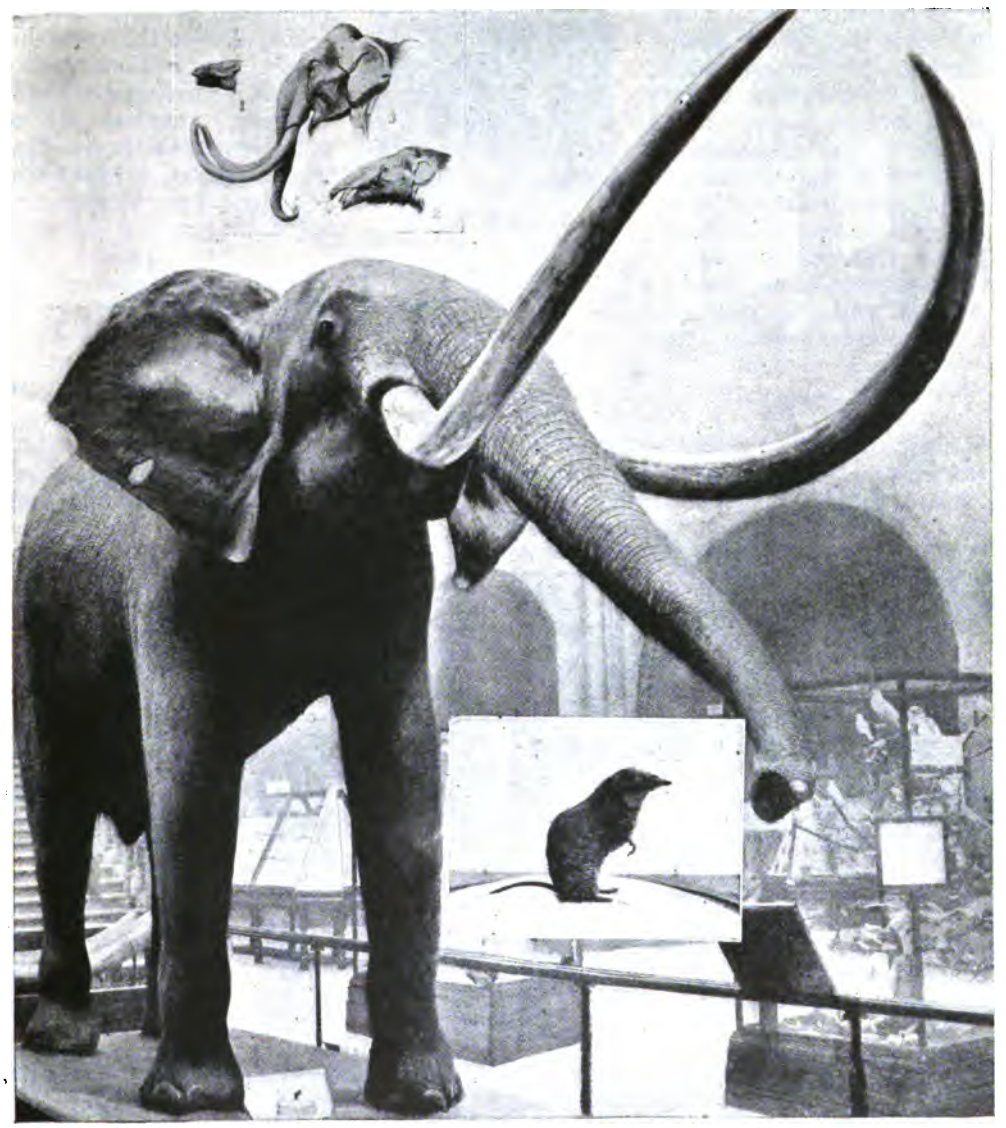
AMONG the many objects of interest at a recent California exposition was a room made from a redwood tree grown in Santa Cruz county, California. The wood, with the exception of rather thin cross sections at the ends, had been removed; the bark banded to keep it in its natural shape, and a door and windows cut in the sides and one end. Enterprising individuals had plastered business cards liberally over its inner and outer surfaces.

MODERN LIFE SAVING GUN.
Piece that fires a projectile carrying a line from shore or pier to vessel in distress. Its high, wide wheels will travel readily over rough ground.

NEW STYLE OF DITCHER.
Open ditcher cutting a ditch with a twelve-inch bottom and a two and one-half foot top, to a depth of four and one-half feet.

WONDERFUL RESEMBLANCE

A VERY strange thing has come to light in the Natural History Museum, in London, by the chance comparison of the largest and the smallest mammals. A specimen of the huge African elephant has been placed with a tiny little pigmy shrew mouse on the floor between its feet. The mouse is in length only about one-fifth of the elephant's eye. The two mammals were placed together at the instance of Sir E. Ray Lankester, who obtained the elephant for the Museum. His object was to emphasize the wonderful fact that, in spite of the immense divergence in size, the monster elephant and the insignificant mouse are almost identical in structure. The tiny mouse has practically every bone, muscle, blood-vessel, and nerve that is to be found in its enormous neighbor. Of the two



STRANGE LIKENESS BETWEEN HUGE TUSKER AND TINY MOUSE.

smaller pictures within the larger, that below shows the mouse on a larger scale. The picture at the top shows the stages of evolution of the head, proboscis, nostrils, and tusks of the elephant. Head No. 1 is that of the Mœritherium of Eocene Libya, with a flexible upper lip and small incisive tusks. No. 2 is that of a Palæomastodon of Eocene Libya, with a short proboscis and powerful upper and lower tusks. Head No. 3 is that of the fossil mammoth found in Indiana, with gigantic upper tusks and long proboscis with nostrils at the tip.

BURROS AT WORK.
Valuable animals said to outdo the mule.

AUTO SAWS WOOD

THE accompanying photograph is of a unique wood-sawing outfit recently constructed by an enterprising blacksmith, Joseph Rix, of Millers Falls, Mass. He made a frame carrying a saw arbor and jack shaft which he bolts upon an old twenty-four horsepower automobile in place of the detachable rear seat. He drives the jack shaft by belt from the fly-wheel of the motor. The jack shaft in turn being belted to the saw arbor. While this outfit has a somewhat freakish appearance it is proving itself to be a very practical device, greatly extending the limit of territory usually worked over by a horse-drawn sawing outfit.

AUTO RUNS CIRCULAR SAW.
New scheme for making a car pay a profit.

WORTH OF THE BURRO

A BURRO that costs $5 will walk a $500 mule to death. The old prospector who built a box body out of old fence boards and mounted it on a pair of buggy wheels, drove the team shown in this picture behind a six-mule stage team from Cripple Creek to Colorado Springs in nine hours and returned next day, a distance of sixty miles.

GAME FOR A PICNIC.
Boys race to see who can get through his barrel first.

SQUEEGEE APPLIED TO STREET.
This cart cleanses pavement just as its namesake, the rubber rake, cleans a window.

LINE-UP OF TAXICABS.
Shipment recently made from an Ohio factory to San Francisco.

CLEVER BOY'S INVENTION

WEARY of using bungling chalk and a string in describing circles on the blackboard in working out geometrical problems, young Ralph Coxhead, a bright fifteen-year-old boy student in the Oakland, California, high school, has invented a blackboard compass that promises to prove a very valuable accessory to all school rooms.

MASTER RALPH COXHEAD AND THE INSTRUMENT THAT HE HAS INVENTED.

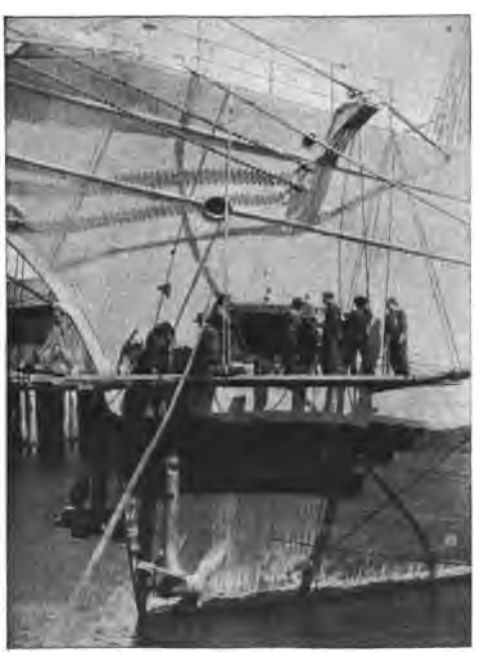
This instrument is made of aluminum and brass, and through an ingenious pivotal arrangement any desired diameter can be secured. The compass is simple and compact, and on either side of the aluminum frame are graduated scales to guide in setting the point for the desired diameter. A rubber suction base firmly attaches it to the blackboard, and it can be attached or removed in an instant—thus expediting work in the school rooms.

Young Coxhead has already secured a patent on this ingenious device. He has received many letters from mechanical engineers and inventors highly commending his invention and is now considering offers from several firms who would adopt it as a commercial proposition.

CUTTING PORTS FOR CARGO

MOST of the sailing vessels built along the Atlantic Coast or in foreign ports, are designed primarily for the transportation of wheat, coal and other commodities of a like nature. When these vessels arrive on the Pacific coast, where the chief article of export is lumber, they are seriously handicapped through not having suitable ports for the expeditious loading of large timbers. Hence many ships, when wheat charters are not to be had, go to the expense of having ports cut, so as to be in a position to qualify as lumber carriers. While it is a comparatively easy matter to cut ports where the vessel is of wood, it is a different proposition where the ships are constructed of steel plates three-fourths of an inch in thickness.

The work performed recently upon the French ship *Helen Bloom,* in Puget Sound, as shown in the illustration, was done with the aid of pneumatic tools; but even then the cutting of two ports each four feet square took several weeks' time, and cost about $2,000.



CUTTING NEW PORTS IN A VESSEL.
Grain carrier prepared in port to carry lumber on return trip.

GOVERNMENT TURNS BUTCHER

THE lieutenant-governor of Winnipeg has set forth the advisability of a government-owned abattoir, where small butchers could have their stock killed and dressed as needed and not be required to depend upon private interests. Some time ago, a movement against high prices, started in Winnipeg, with special reference to the meat industry; and the government will enter the field.

150,000 BEADS MAKE A VEST

ABOUT one hundred and fifty thousand beads of various colors were used in making the remarkable vest pictured on this page. They are strung on deer sinew and completely cover the buckskin upon which they are stitched. The design of the garment is very beautiful, representing in front, two Sioux warriors mounted on galloping ponies and attired in the war bonnets of the tribe. Each is carrying a feather-bedecked lance. A decorative symbolic device occupies the space above the figures. The back of the vest is no less beautiful, and likewise represents two mounted braves and two stags as well. The decorative grouping of the figures is exceedingly skillful. The body of the vest is of white beads, and the figures are blue and red. Its weight is about five pounds and required a full month's work of a squaw on the Pine Ridge Reservation. The Indian's holster, cartridge belt, cuffs and sleeve band are all of the same material, and even the saddle blanket and bridle of the pony are composed of this attractive bead work, and it will be noticed that feathers are used to give a finishing touch to the headstall.

RED WING.
The young wife of James Young Deer.

The owner of this outfit is James Young Deer, who was born about thirty years ago on the Winnebago Reservation in Nebraska, the son of Green Rainbow. He was educated at Carlisle and is married to Red Wing, a Carlisle graduate of his own tribe.

JAMES YOUNG DEER.
Who owns a wonderful jacket of beads.

150,000 BEADS.
Back of the remarkable jacket made by Indian squaw.

THE TAPIR

OUR photograph shows a young tapir, an animal known in Europe only since the end of the eighteenth century. The tapirs are found in South and Central America, as well as in southern Asia, where they live in woods and marshy places. They are peaceable plant-eaters and excellent swimmers, and when full grown are from six to nine feet long and about three feet high.

BABY TAPIR.

This little chap was captured in his early childhood by an English hunter. He looks like a playful little puppy, all head and feet, but most puppies would be likely to shy away from his striped sides.

BUDDHIST MASKS

THE masks shown on this page are fac similes of those worn in the greatest festival of the Lamaist Church, the Losar, the New Year Buddhist Feast, held at the beginning of February, in remembrance of Buddha's victory over the six heresies, the victory of the true religion over infidelity. Dr. Sven Hedin says of its celebration in the monastery town of Tashi-Lumpo: "Lamaism is only a corrupt form of pure Buddhism, and under an outward varnish of Buddhistic symbolism has incorporated a number of Sivaistic elements, and has also retained the superstitions which in pre-Buddhistic times found expression in wild fanatical devil-dances, rites, and sacrifices. The object of these ceremonies was to exorcise or propitiate the powerful demons which reign everywhere, in the air, on the earth, and in water, and whose only function is to torture men. Lamas dance in hideous masks with large evil eyes and Mephistophelian eyebrows, distorted features, and huge tusks; others represent mythical wild beasts, all equally terrible."

WHAT THERE IS IN A TEAR

A PITILESS, or cruel and learned chemist has analyzed human tears. Tears of love, tears of regret, tears of anger, common tears, obtained by the use of an onion. He has distilled all, evaporated all, weighed all, and this is what this terrible man says:

Human tears contain 984 parts of water, almost sixteen parts of salt. There also enter in very small amounts of albuminoids, some organic matter, mineral salts, sulphates, chlorines and phosphates.

Is there a difference in composition between sincere tears and those called crocodile? The specialist does not tell us. Perhaps between true emotion and hypocrisy there is an appreciable difference in sulphate or chlorine. Perhaps there is little difference, who knows?

A popular old proverb tells us, "Few people have lived without laughing. None have lived without weeping." The modern maxim "keep smiling," is based on a true psychological, if not physiological principle, however, that makes it worth while to practice, at least for the sake of one's friends.

A MONSTER WHALE

THE whale in the accompanying photograph was captured near Port Arthur, Texas, on March 8th, 1910. It is of the tropical sperm species and has been announced authoritatively as being the largest of its type of which there is any scientific record.

The mammal measured sixty-three feet and seven inches and was about 300 years old. Captain Cot Plummer, mate of a local U. S. pilot boat, sighted the monster floundering in the shoals off the Port Arthur jetties. The crew succeeded in fastening a six inch rope about its tail and brought him in.

EARRINGS OF NIAS.
Disfiguring "jewelry" worn by island men.

WHALE THAT WAS A MONSTER.
He was sixty-three feet long and 300 years old when killed off Port Arthur, Texas, in March last.

ELECTRIC HEATED GARMENT

THE newest invention in therapeutics is the electric heated garment. At present it is made up in the form of a lounging robe of wool material, containing an interlining in which 7,000 feet of specially constructed copper wire is inserted. This wire is as pliable as thread, unbreakable and durable, and so light that it only adds about twenty ounces to the weight of the robe. After electric connection is established, a gradual rise of temperature takes place to about one hundred and thirty-five degrees Fahrenheit. The body warms up in the same proportion, giving a very pleasant sensation. The temperature is regulated by a simple switch, held in the hand. The connection may be made to any electric light circuit, direct current or alternating current having a difference of potential of 110 volts.

The uses of this Electric Heated Garment are many-fold and the results so far obtained are favorable. It is recommended for invalids and is a comforting possession.

ELECTRIC HEATED ROBE.
Garment that can be warmed by current from [illegible] socket.

EARRINGS EXTRAORDINARY

THE most remarkable earrings in the world are worn by men, on the islands of the Nias Archipelago, off the west coast of Sumatra. These ornaments are thin hoops of pure gold, sometimes double, like the one shown in the photograph. They deform the ears greatly, but in Nias, as well as elsewhere, it is considered worth while to suffer in order to be beautiful.

PRIMITIVE PAPER MAKING.
Curious Chinese hammers for breaking up bamboo refuse to be made into paper.

AN ARCHITECTURAL SPASM.
This photograph from a western suburb is a warning against the theory that every man is qualified to be his own architect.

PRIMITIVE PAPER MAKING

IN China, everything is reduced to the lowest possible terms of cost—a fact that is illustrated in an interesting way by the accompanying photograph, showing a primitive and inexpensive process of paper making. The raw material is bamboo refuse, which is being pounded to pulp by a couple of huge hammers of wood. The hammers are operated by a water-wheel, a running stream doing the work. The chinaman in charge of the mill is not seen because he was frightened away by the camera.

IVAN, THE GREAT.
Big brown bear recently placed in New York Zoo.

"IVAN" THE GREAT

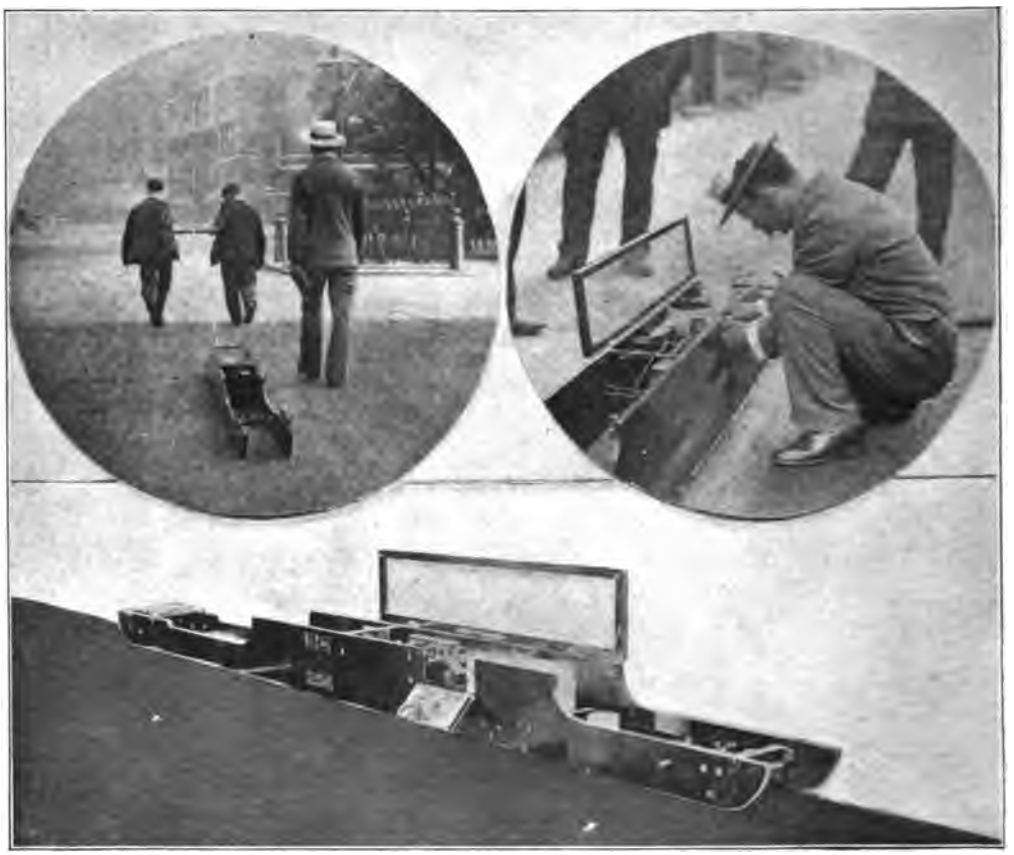
ONE of the largest and finest specimens of the giant brown bears of Alaska, in captivity, is the monster "Ivan," now in the New York zoological park, weighing nearly 1,000 pounds, over eight feet in length and four and one-half feet high at the shoulders. A picture of this great creature is shown in the accompanying illustration. Ivan was captured at Muller Bay, on the Bering Sea side of the Alaska Peninsula. This is one of the few regions where the brown bears are now to be found.

CARRYING AN ELEPHANT SKIN.
African bearers bringing out portion of hide of huge beast shot in the jungle.

PROTECTING THE X-RAY OPERATOR.
Cabinet designed by French inventors to prevent evil effects on physician who uses X-Ray on patients.

LEVELLING ROADS

THE viagraph is an ingenious instrument for measuring road-wear. Its principal working parts consist of a steel-shod skate, shaped like a section of an ordinary cart wheel, and a small cogged wheel, both of which are in continual contact with the surface to be tested. Inequalities in the road over which the viagraph passes are communicated by the skate through the medium of delicately-adjusted levers to a paper-covered cylinder, upon which a pen records a profile of a road traversed on a scale of ⅛ in. to 1 ft. A system of decimal dials shows at a glance the sum of the depth of all the inequalities of the road. Eye inspection cannot be relied upon in such matters, for no two persons would estimate the depreciation alike. In binding contractors to definite quality in laying down and maintaining roads, the viagraph affords undeniable proof of its merits, for by its use any excess in the indicated wear indisputably convicts the contractor of neglect. The instrument is made by a well-known firm in Scotland and used on English roads.



APPARATUS FOR REGISTERING ROAD IRREGULARITIES.
The sled-like device is dragged over a road, while delicate mechanism records the inequalities in the surface.

TO SOLDER GLASS

TO solder pieces of glass together, melt 95 parts of tin and add five parts of copper, stir well with a wooden rod and the mixture will unite with the glass so thoroughly that it can be used for the connection of glass tubes, etc. Adding half to one per cent zinc or lead renders the mixture more or less hard.

This is a useful solder for handlers of glass who desire lasting strength in united parts when impractical to weld.

AN ELEPHANT'S BATHTUB.
Gigantic plunge for huge animal, recently built at the Washington Zoo.

BATHTUB FOR AN ELEPHANT

THE new idea in the management of any "zoo" requires that the animals therein contained shall be made as happy as possible. This is a matter not only of humanity, but also of business, inasmuch as wild beasts and birds in confinement survive much longer if conditions are such as to render them contented and cheerful. At the zoölogical garden in Washington, for example, a bathtub has been provided for the elephants. It is here shown in process of construction. Lined with cement, it is quite as luxurious, from the pachyderm's standpoint, as the porcelain tub in which a millionaire enjoys his ablutions. There are no silver faucets, but the supply of running water is unlimited, several thousand gallons being turned on for each bath.

MOTOR CAR A SWITCH ENGINE

THE remarkable power of the modern motor car is indicated in the accompanying illustration where it has taken the place of the locomotive about the switching-yard of the motor car plant at Detroit when a car has to be pulled to the shipping-platform. In the absence of locomotives the shipping-crew frequently hitched a machine to the freight-cars to pull them into line. This is only one of a series of remarkable tests given to modern motor cars and is paralleled by other stunts of ingenious sort.

AUTO PLAYS LOCOMOTIVE.
Switching freight-cars by means of a motor-car.

WHERE CHEWING GUM COMES FROM

THE chewing gum tree grows in Mexico. But the gum it yields has no flavor—which is one of the most particular reasons why it is useful for the purpose.

The tree is known in Mexico as the " chicle" tree, and the gum itself as "chicle." As for the gum, it is an exudation from the bark. In the accompanying picture, a native is seen in the act of climbing a tree to gather chicle, using his prehensile and educated toes to help him. An ordinary man would not be able to climb a tree in such a fashion.

EARLY MOTOR CAR.
Curious relic now in the National Museum.

The gum is extraordinarily viscous and "chewy"—a quality which renders it highly suitable for chewing gum. It is also one of the most tasteless things imaginable, so that, being absolutely neutral in this respect, it is easily made to adopt any desired flavor by the admixture of the required ingredients.

EARLY TYPE OF MOTOR CAR

ONE of the most interesting objects in the government's collection of patent models, preserved in the National Museum at Washington, is a very early type of electric motor car. This was the invention of Moses G. Farmer, and excited an immense deal of interest and even wonder. Mr. Farmer was an electrician of some repute and travelled about the country giving lectures on electricity. In 1847 he exhibited the car shown in the picture, which was of his own designing, causing it to run on rails around the lecture hall, carrying four children. It is easy to imagine how striking such a novelty must have appeared to audiences in that day.

AFTER CHEWING GUM.
Native climbing the "chicle" tree, of Mexico.

QUEER ADVERTISING.
Strange figure used to attract attention.

GASOLINE WASHER.
Power machine for cleansing fabrics with great rapidity.

FREAK ADVERTISING

A PIECE of advertising that is designed to rack the nerves is shown in the accompanying photograph. A life size model of a man is shown hanging perilously from the eaves of a building and struggling to recover his safe position on the roof. The supposed victim is made of tin, but highly colored and realistically modeled, so that a person who was very ignorant and very near sighted might possibly imagine that he was witnessing a tragedy. In every case the unfortunate man of tin is in the employ of some leading establishment of the town, for he carries on his back a placard bearing the name of the firm, and thus in his life struggle advertises his owner.

A CONTRAST

WHEN man took a crooked stick and began to till the soil, using first the force of his own muscles, he made his first step toward civilization. Later he learned to apply the power of the animal to the work. Upon cultivating the soil, he became master of the plants and shaped them to serve his purposes. With the plow the savage life of the hunter and the nomad life of the herder gave way to that settled agriculture that now yields our food supply and upon which rests our modern civilization.

THE CROOKED STICK PLOW.
Japanese laborer with ancient implement.

MODERN OIL TRACTOR PLOW.
A wonderful contrast to the picture reproduced above.

Strangely enough, this work of plowing with which man began his systematic labor remains today still his severest toil. For man, as well as animals on the farm, the dusty and monotonous work of plowing is the hardest drudgery. Think of the power required to pull a plow only the distance across the room, and then of the eight miles of furrow-travel in every acre of land.

The kerosene-oil tractor shown in one of the pictures is now being used for plowing, for seeding, harvesting, cultivating, threshing, clover hulling, for hauling grain to the market, for pumping water on the farm or at the irrigation plant, for railroad building, lumber hauling, for bringing ores and other heavy materials to railway points. In addition to serving these general purposes, it is found of great value for special needs, wherever either traction or belt power is required.

HOUSE MADE LIKE A BASKET.
Dwelling constructed of withes woven together.

HOUSE-BUILDER'S MATERIAL.
Plant that furnishes the withes.

HOME BUILT LIKE A BASKET

THE *ramada* is the name by which the woven dwelling of the Indians is known in the Southwest. The *ramada* is constructed with corner posts made of forked cottonwood trunks set upright and supporting the rough hewn cottonwood limbs upon which rest the improvised rafters and sagging roof. The walls are filled in with woven brush, chinked with mud and strengthened by long transverse branches, or poles of the ocotilla cactus. These cactus poles are also very convenient as roofing material; being laid across the rafters and thickly daubed with mud, they make a fairly waterproof covering for the primitive home.

OBVIATES BLASTING

A NEW method of preventing explosions of coal dust in mines has been tried in German mines, which under certain circumstances makes blasting superfluous. Water is introduced under high pressure into a deep bored hole of a coal body, the hole closed, and the pressure allowed to act upon the coal until water is forced out through the fissures. The coal is thus wet while loosened.

WHEN TIMES ARE GOOD.
Typical mill in the coke region.

COKE IN THE MAKING

COAL to the value of $23,250,000 is turned into coke in the state of Pennsylvania in a single season. That is rather more than half the total coke output for the whole country. Coke is employed extensively in the manufacture of iron and steel because of the intense heat it gives off and also because of its freedom from troublesome by-products like tar and ammonia, which militate against the use of coal. The old-fashioned beehive oven is gradually giving way to the retort oven in which it is possible to save these by-products, which are wasted in the bee-hive ovens. The latter, however, are still those most commonly seen. They are twelve feet, three inches in diameter and are fed with coal through the top. The fire is kept burning from 24 to 72 hours, when it is extinguished with pure mountain water. The coke is then drawn out with heavy iron scrapers and loaded upon the cars. Less time is required for transforming the coal into coke when the retort oven is used and the coke is ejected by means of a machine which thrusts a ram into the oven on one side and forces it out through an opening on the opposite side into the waiting cars.

The coke-making regions are unpleasant places when the mills are running, but they turn out a valuable product.

WEIGH YOUR COAL WITH A FOOT RULE

IT is a useful thing to know that coal in the bin can be weighed accurately by measurement. The following figures are given out by John Kjellander, city sealer of Chicago, by which the householder may know whether or not his dealer has delivered him the ordered amount of fuel, by measuring the cubic contents of the bin. The table explains itself:

	Lbs. per Cu. foot	Cu. feet per ton
Lehigh Lump	55.26	36.19
Lehigh Cupola	55.52	36.02
Lehigh Large Egg	56.85	35.18
Lehigh Egg	57.74	34.63
Lehigh Range	58.15	34.39
Lehigh Chestnut	58.26	34.32
Lehigh Pea	53.18	37.60
Lehigh Buckwheat	54.04	37.01
Lehigh Dust	57.25	34.93
Free Burning Egg	56.07	35.67
Free Burning Stove	56.38	35.50
Free Burning Nut	56.88	35.16
Pittsburgh	46.48	43.03
Illinois	47.22	42.35
Hocking	49.30	40.56
Indiana Block	43.85	45.61
Erie	48.07	41.61
Ohio Channel	49.18	40.60

THE FINISHED PRODUCT.
Coke as it appears when ready for the market.

Pocahontas Egg Lump....	50.00	40.00
Iowa Lump	50.00	40.00
Connellsville Coke	26.30	76.04
Scranton Large Egg.....	56.85	35.20
Scranton Egg	57.75	34.65
Scranton Range	58.15	34.40
Scranton Nut	58.25	34.30
Scranton Pea	53.20	37.60

NEW POTATO DISEASE

THE wart disease is a new enemy of the potato crop which is attracting great attention in Europe, and which is likely to be introduced into the United States at any time. It affects the tubers, forming large, rough, unsightly warts, and, in severe attacks, completely destroys the crop. Once the fungus gets into the soil, it is impossible to grow a crop of potatoes on the land for several years. The U. S. Department of Agriculture has recently issued a circular, for free distribution, giving a brief account of this disease.

UNUSUAL CONCRETE CONSTRUCTION.
Support for railway water-tank, built by an Eastern firm.

SAW THAT CUTS NICKEL STEEL.
Slicing "bologna" of extremely hard metal for auto-gears.

BUZZ-SAW CUTS STEEL

A BUZZ SAW which eats through chrome nickel steel like wood is one of the modern machine tools which help us to cheap automobiles—and other cheap things—which are good. The old power hack-saw answered its purpose fairly well until the steel makers got busy and gave us the new steel alloys both hard and tough. The hack saw might hackle a tool steel billet all day and not get through. If it succeeded in sawing off a slice, the slice would not be likely to be of uniform thickness. Moreover, the sawed surface would be rough.

The new invention saws ordinary iron at the rate of an inch a minute. With the saw blade in good condition, it can saw a six inch bar of hard tool-steel at the rate of three-fourths of an inch per minute. Frequently it saves fifty per cent. in the cost of sawing. The saving is due to the fact that it saws a straight, smooth cut, that the sawed surfaces need not be dressed and stock is saved. Some of the new steels cost a dollar a pound. When a piece is wanted it pays to saw off only just enough for the purpose.

To prevent clogging of the blade by the tough steel chips and to minimize friction, a stream of oil is kept running on the blade by means of a pump. The teeth are peculiarly ground. Every other tooth is .012 of an inch longer than its neighbor. These long teeth are beveled. They make the center of the cut. The shorter teeth are ground square and left the full thickness of the blade. They gouge out the sides of the cut.

SPIDER'S NEST A FLY-TRAP.
Curious home of spider which Mexicans use to rid their homes of winged pests.

SPIDER'S NEST USED AS FLY TRAP

IN Mexico, in certain localities, there is a singular custom among the people which consists of suspending in their apartments the nest of a sociable spider, to which the flies come and get caught, thus ridding the houses of disagreeable guests.

The spider in question is the coénothīle gregalis, of the family Dictynides; it is rather clumsy, thick and short, and measures not more than five mm. It lives mostly on oak trees which grow at an altitude of 7,500 feet.

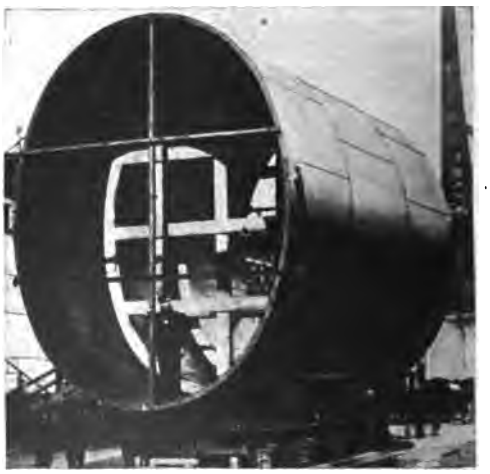
These nests, which the natives call mosquéros, vary in size. They sometimes cover a space of six feet. The exterior of the nest is composed of an envelope of two kinds of thread. One somewhat stronger than the other forms the cables which, extending from one branch to another, constitute the cordages which maintain the edifice. The other threads called calamistrés, softer and glutinous, serve to capture the prey. The interior of this pocket is filled with a network of threads inextricably entangled. Among them numerous cells and galleries are skilfully distributed which gives the mass a spongy appearance.

Many females live in the interior of the nest and do the housekeeping. The males do not seem to reside in the nest, only appear there for a moment from time to time.

Besides the legitimate proprietors there is found in the nest another very small insect, the coléoptére of the species Melanopthalma, upon whom seems to devolve the house cleaning of the habitation. It is the spider's valet de chambre. It tears up in small pieces the prey already partly devoured by the coléoptére, and eats them. So they disappear and the nest is always perfectly clean.

Besides the coléoptére there is another guest at the table. It is a murdering spider of the Drassides family the Poecilochroa convictrix, who apparently finding an easy and well assured existence makes himself the guest of the house; the latter species has, judging from appearances, the benefit of the daily captures; but if for any cause the usual food fails, it is probable that he has recourse for his nourishment, to the coénothīle who gives him shelter. Each year as the rainy season approaches, the Indians go into the wooded mountain region to gather more mosqueros and bring them back to their homes. They suspend them to the ceilings of their rooms where from that time the spiders continue to live as if they were at home. They place these nests not only in the rooms which they occupy but in their barns and stables as well.

NON-SKID ATTACHMENT.
English invention for preventing slipping of bicycle wheels.



SECTION OF A LINER'S FUNNEL.
Giant stack of an ocean grey-hound, which has a diameter more than three times a tall man's height.

These spiders although of very small size do not hesitate to attack insects much larger than themselves, for instance the gad fly and horse fly who never give domestic animals any rest.

A curious thing is that these nests seem to exercise an irresistible attraction to winged insects, which is owing perhaps to their color or some peculiar odor that our sense of smell is not sufficiently subtle to perceive.

The mosquéra grows larger concentrically, so to speak, after each capture; when an insect comes and gets caught he is immediately seized and covered in a cell by the spider who makes him his prey; the melanopthalma comes afterwards and benefits from the remains of the capture, which he causes to disappear, leaving thus an empty place which becomes a new cell which will afterward be occupied by the guest of the house.

The colonies do not live indefinitely. During the rainy period, they decay, evidently by drying. Later they are replaced when again winged insects become too disagreeable.

STAGE DECORATION AND LIGHTING

IT took the trained eye of a painter, Mr. Meriano Fortuny, of Venice, to discover the fault of the present method of stage illumination. Mr. Fortuny made extensive experiments together with the Berlin General Electric Company, and now has worked out a new system, by which the stage decorations appear almost as seen in Nature.

TO MAKE THEATRICAL CLOUDS.
Machine that throws reflections on stage-sky to imitate vapor masses.

STAGE-SKY AS SEEN FROM REAR.
Dome-like arrangement of backing now used to produce striking illusions.

TO DIFFUSE STAGE LIGHT.
Surface of cloth from which reflections are thrown upon scenery to imitate daylight.

He uses arc lights exclusively, the color of which more closely resembles that of the sun than that of the electric bulbs heretofore used. In order to obtain a diffused light, the light is not thrown directly on the stage, but is reflected from surfaces of cloth. These consist of broad strips, partly of light and partly of dark material, as shown in our picture, and are stretched over rollers, so that by turning, the reflecting surface can be made bright or dark to suit requirements. It can also be given any desired color, by placing stained glass slides between the arc lamp and the cloth. In order that the correct lighting effects may be obtained, this machinery is regulated from a place in the audience in front of the stage, and, therefore, the operator can closely follow the course of the play.

The straight piece of background which heretofore used to represent the sky, is unnatural, for in Nature the sky appears to us like an arch. Mr. Fortuny's sky is round, as our picture shows.

REMARKABLE CASTING METHOD.
Indian moulds and metal goblet made in them.

FATAL CAR ACCIDENT

A BAD wreck occurred recently on an electric railway company's line in Pennsylvania where several people were killed and many injured. The accident shown was the thing which aroused the councilmen of one good-sized city to action and they forthwith ordered the road to suspend operations. Besides the remarkable fact that this accident caused the road to go out of business the details of the accident themselves are very unusual. The hill, of which the photograph shows the bottom, is over a mile long, on an irregular grade, and the car shown started down filled almost to the doors. The motorman tried to stop but the air-brake was out of order. He then tried the handbrake but the slippery rails and the momentum of the car carried it on. At a speed said by spectators to approach forty-five miles an hour, the car rounded the curve and had almost gotten clear to go under the bridge when the rear trucks came off and the front end of the roof shot up and was crushed in by the bridge. At the same time the car was sideswiped by the stone abutments. The photograph shows the situation.

A FATAL CAR ACCIDENT.
Wreck that cost lives because car hit bridge.

INDIAN METHOD OF CASTING

IN the wonderland, India, a method for making cast metal objects has been used since time immemorial, which even at the present day is quite frequently employed by us, for making richly decorated articles. Our picture shows an iron goblet, which according to this ancient method was made as follows: A lump of clay shaped like the hollow inside of the goblet is carefully and evenly covered with a mixture of fat and wax, and all parts of this wax goblet are then thickly

PICTURES OF THE CINEPHOTE.
New device makes moving portraits possible.

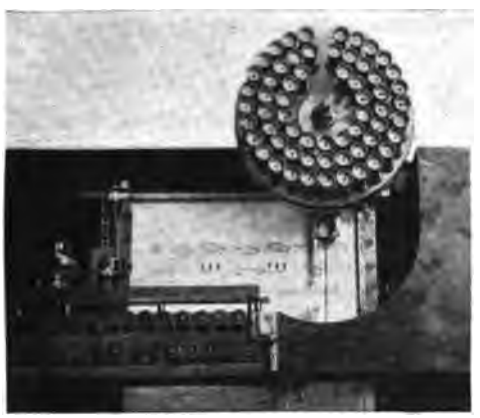
covered with clay, only a small opening being left at one side as the picture shows. This body is then slowly dried next to a fire, and as soon as the clay becomes heated, and the moisture is evaporated, the wax melts and runs out of the hole, leaving a hollow space inside, that has the exact proportions of the goblet. Then the metal is poured in, and when cooled and after breaking the clay, a perfect article is obtained.

THE CINEPHOTE

ANIMATED photography, for various reasons, has until the present time, been reserved for professionals only. The difficulties are numerous. It demands bulky and costly material, and delicate manipulation is necessary, which would be impossible to one who does not possess special equipment.

The cinephote avoids these inconveniences and places cinematography within the reach of all amateurs. The views that it is possible to take with the cinephote are by no means equal to the remarkable scenes that are registered today by the cinematograph, but it is interesting and accomplishes the same results on a smaller scale.

With this instrument it is not the registering of prolonged performances that one attempts, but simply the taking of a momentary motion. With it an amateur



MUSIC-WRITING TYPEWRITER.
Machine that records musical composition as ordinary typewriter does words.

can easily obtain of his friend or of his child a living picture.

The cinephote is composed essentially of two instruments, the first serves to take the views, the second to make them move with the desired rapidity; both are automatic, and their mechanism very simple. The taking of views is effected on a sensitive disk which takes 25 to 75 successive proofs.

ANCIENT HUMAN RELICS

IN an illustration at the top of this page the skull of the woman of 600,000 years ago is shown on the left; that of an Englishman of 60,000 years ago in the middle; that of a man of the present day on the right. The woman's skull, which is in the museum of the Royal College of Surgeons, London, was found at Gibraltar a good many years ago. Professor Keith fixes the date of her life.

SKULLS OF A WOMAN OF 600,000 YEARS AGO, OF AN ENGLISHMAN OF 60,000 YEARS AGO, AND OF A MAN OF THE PRESENT DAY.

DRUMS OF HUMAN SKULLS

PICTURED below are two drums made from human skull-caps. Two skull-caps are required for each drum, the tops being fastened together, while the drum-heads are of human skin. The drumsticks are the radius bones from human arms, so that these musical instruments may fairly be regarded as the most gruesome things imaginable in their way. They were brought from Thibet by Mr. W. Woodville Rockhill, our present Ambassador to Russia. That is a country which is overrun with devils, who would soon destroy all the inhabitants, were it not for the efforts of the priests. The Thibetans impoverish themselves in bribing the "lamas," as the priests are called, to scare the devils away. Fortunately, the lamas know their business, and for devil-driving purposes they employ various kinds of apparatus, including bells and human-skin whips. But the most effective weapons are the skull drums—which, by the way, are beautifully decorated.

DRUMS MADE OF HUMAN SKULLS.
Gruesome instruments used in Thibet. Sticks for them are made of human arm bones.

RUNNING A PRIVATE MINT

HIGH - GRADE counterfeiters almost never bother with making coins. There is too little money in that branch of the business. To make satisfactory imitations of pieces of metal money, moreover, requires expensive machinery—such machinery as those engaged in the industry can hardly afford to buy. Whence it comes about that false coins, as an almost invariable rule, are easy to detect. Those who manufacture them do not long remain out of jail. The outfit herewith shown is of a comparatively elaborate kind. It is a machine for stamping 25-cent pieces, and did fairly good work.

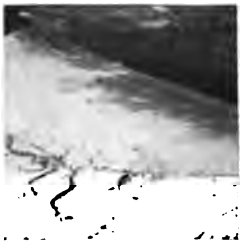
A PRIVATE MINT.
Counterfeiters' den recently raided by United States officers.

GLASGOW MOTOR FIRE-ENGINE

A MOST interesting form of turbine motor fire engine equipped with extension ladder is used by the Glasgow fire brigade. It will climb any ordinary hill with a load, and will start water through the nozzle in less than a minute from the time it is placed in position. An extension ladder is provided and the pump is operated by the same engine which propels the vehicle.

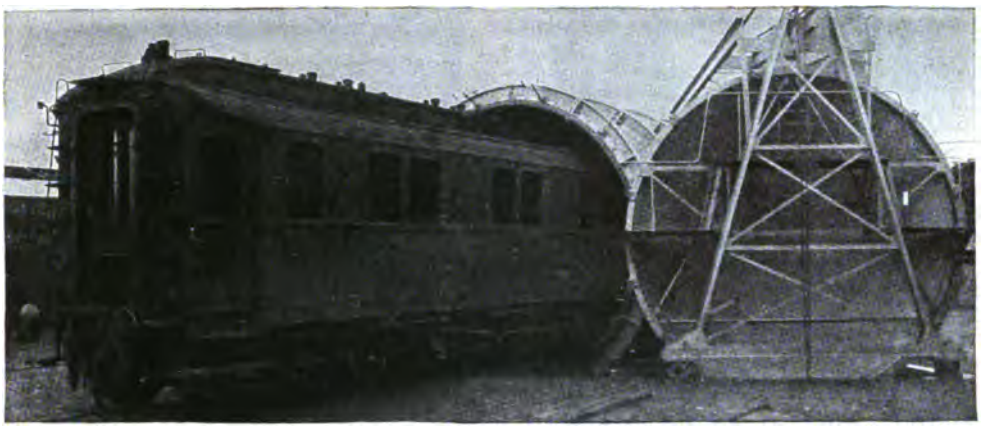
EFFECTS OF A LIVE WIRE

THIS is not a photograph of a malignant cancer but merely shows what happens when a high-power wire breaks and drops upon a cement sidewalk. The cement was melted wherever the wire touched, and the groove is burned to a depth of half an inch or more and glazed like a piece of sewer pipe. Fortunately no one was walking along the sidewalk when the wire broke and the little souvenir of the passage of 14,000 volts was the only consequence of the accident. Those who saw the result, however, will hold distinctly in memory, a vivid idea of danger from the live wire.



BURNS ON A PAVEMENT.
A live wire's work on a cement walk.

NEW MOTOR FIRE-APPARATUS.
Engine and ladder-truck combined for quick use.



DISINFECTING RAILWAY CARS.
A German railroad now purifies all cars by heating with steam in a steel tube from which the air is partially exhausted, and then flooding with formaldehyde gas.

PUNCTURE-PROOF TIRE

THE tire shown in this photograph is shod with solid rubber which is rendered resilient by a system of steel springs. This western invention will, it is claimed, solve all the tire problems, as there is no danger of punctures or blow-outs. In fact, with spring tires, a roadway of broken glass and tacks is ideal. They are claimed to be practically indestructible, lasting as long as the automobile, and as the average pneumatic tire expense exceeds about 75% of the cost of operating a car, they will effect a tremendous economy. The cost of manufacturing these tires is about $15.00 each, so they should rapidly replace the expensive and easily injured pneumatic, as they are said to be quite as resilient.

PUNCTURE-PROOF TIRE.
New invention in auto-tires that is economical.

TUBERCULIN FOR EVERYBODY

FOUR hundred thousand flasks of "tuberculin" were distributed during the last year by the government Bureau of Animal Industry. As everybody knows, the stuff is given to cattle by hypodermic injection, to find out whether or not they are suffering from tuberculosis.

The entire country looks to Uncle Sam for supplies of tuberculin. The states do not make it for themselves, but apply to the authorities at Washington for what they require. It is sent to them, free of charge, in glass flasks, stoppered with absorbent cotton to keep out germs.

The method of manufacture is simple enough. A soup prepared from lean beef is first sterilized by boiling. Then a few germs of bovine tuberculosis are put into it, and allowed to multiply for a few hours. At the end of that time the soup contains billions of them. They are all killed by heating the soup again to boiling point, and then the stuff is ready for use. Tuberculin is furnished only to health officers.

PUTTING UP TUBERCULIN.
Government workers busy getting tuberculosis remedy ready for distribution.

CURIOUS BRIDGE NEAR BELFAST.
Odd arrangement of steel work in form of a spiral.

DOING AWAY WITH MATCHES.
New invention that lights lamps and fires.

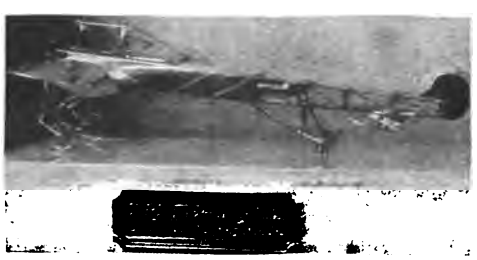
A NEW GASLIGHTER

A VERY useful device has been put on the market recently. A well known scientist discovered that a certain iron alloy on being lightly rubbed with a file will emit intensive sparks which instantly ignite gas. The practical application of this discovery consists of a metal rod holding on its top a little piece of this alloy. On the lower end of the rod is a button which, on being pressed, rubs the alloy against a rough surface, and the spark is emitted. Upright and inverted lamps may thus be ignited. Another very useful application which is shown in the picture is the stove lighter. The alloy is fastened on the end of the lower leg which, on being pressed upwards, rubs against a vertical roughened surface. In releasing the hand pressure the lower leg jumps back to its original position by means of the spring like action of the rod, thus causing the alloy to spark violently. It is even possible to light gas lamps at the top of masts, merely by turning the cock, a slight gas pressure starting a mechanism to light it. The alloy itself is practically indestructible and very cheap.

A CAT-GODDESS.
Statue of Egyptian deity, once worshiped as divine.

STATUE OF A CAT-GODDESS

IT is said that the Egyptians of old were first to domesticate the cat. Undoubtedly they worshiped the animal, considering it sacred, at least in a sense, as they did the crocodile and the ibis. One of the most remarkable works of ancient Egyptian art is this bronze statue, fortunately well preserved, which represents the cat goddess. It is, indeed, very beautiful, and the face of the animal is well done.



GOLD MODEL OF BLERIOT MONOPLANE.
Memento of famous Channel flight given to the Princess of Wales, recently, by members of the British Aero Club.

BAYEAUX TAPESTRY OF HALLEY'S COMET.
Curious record of impression made by celestial phenomenon in time of William the Conqueror. Supposed to have been woven by William's queen.

PLOWING WITH OXEN IN THE SANDWICH ISLANDS.

PRIMITIVE PLOWING

NOTWITHSTANDING that the group of Sandwich islands belongs to the United States government, yet the methods of cultivating the soil still remain very primitive and crude. The accompanying photograph shows the favorite method of plowing. The beasts of draft are a species of Indian buffalo that were originally brought from the Orient, and are smaller than the average American ox. Instead of a regular yoke, a crude, awkward affair is substituted—a sort of rough wooden collar, attached to which are ropes wrapped around the horns of the animals. These are fastened to iron rings that are passed through the nostrils of the patient, sturdy creatures. It is by means of the ropes and rings that the team is guided. In the photograph a young tourist was holding the plow.

UNDER MONORAIL CAR.
How the wheels look on a single rail.

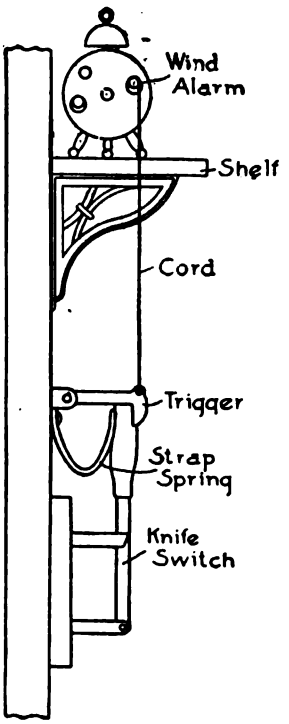
REMARKABLE AMERICAN ENGINE

THE accompanying illustration shows the construction of an enormous Corliss engine for heavy duty in rolling mill service at the works of one of the great American steel companies. This engine was designed for a 22 inch mill and has a total weight of 750,000 pounds. This engine was built at Hamilton, Ohio, and develops 5,000 horsepower.

ENGINE THAT WEIGHS 750,000 POUNDS.
Huge stationary steam-engine recently constructed for the Carnegie Steel Co.

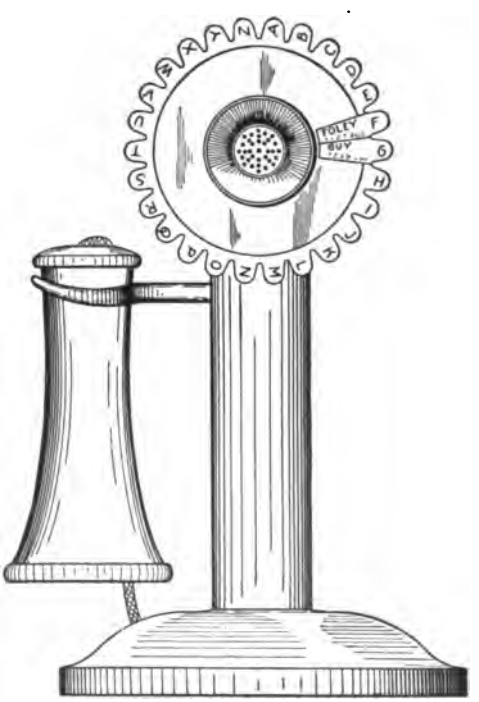
TO TURN OFF ELECTRIC LIGHTS AUTOMATICALLY

THE accompanying sketch shows an arrangement by which an alarm clock may be used to turn out the lights at any desired time. A cord is fastened to the alarm key on the clock so that it will wind up when the spring unwinds. This cord should be connected to a trigger, as shown, which will be pulled, and release the handle of a knife switch to which the lights are connected. The strap spring will throw the knife switch out when the handle is released.



INGENIOUS TELEPHONE DIRECTORY

AN excellent adjunct for the telephone is a device intended to supplement the cumbersome and burdensome directory. It consists of a circular disk with indexed divisions for the insertion of the names of persons frequently called. It is intended to be placed on the telephone transmitter and the lower disk is revolved until the opening discloses the name and number desired. With this device the number is always directly in front of the person talking and removes the difficulty of endeavoring to remember the telephone number desired. This is the invention of an Ohio man and is useful.



DELIVERING LETTERS BY PHONE

THERE has been for some years more or less complaint of the non-delivery of mail on Sundays in London. An arrangement has now been made by the British post-office by which letters posted in the country on Saturdays can be delivered in London by telephone on Sundays. When it is desired to have the contents of the letter telephoned on Sunday it is inclosed in an envelope addressed to the central telegraph office in London, and a broad line is marked across the envelope from top to bottom. Postage stamps to the value of three pence—six cents—for every thirty words are forwarded. The postmaster-general states that the new scheme, while giving considerable additional facilities to the public, will add little or nothing to the amount of Sunday attendance by the post-office staff. The telephonists and others who will deal with the messages in London must in any case be on duty, the telephone exchanges being open all Sunday. On the other hand, there will probably be some reduction in the force now employed to deliver telegrams and express messages on Sundays.

The plan is susceptible of application in many other cities and may become useful when Sunday messages are important.

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A WONDERFUL JUMP.

This remarkable photograph of a horse's leap was taken recently at a private circus in Paris. The rider is a professional horsewoman. She holds the record for the jump without obstacles. The horse is an Anglo-Arabian, from Tarbes, and is six years old.

THE TECHNICAL WORLD MAGAZINE

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IN THE YEAR OF THE COMET

By

BAILEY MILLARD

STAGGERING questions, not unlike some of the posers with which children stump their elders, have been put to many scientific men in relation to the supposed effect of Halley's comet upon our pleasant planet. Over and over again have the wise ones been asked, Was the comet responsible for the unprecedented atmospheric and seismic disturbances that brought so much woe to the human race during the first half of the present year? Is a man a superstitious fool to blame any of those cataclysmic upheavals, devastating inundations, terrible typhoons, frightful and unseasonable frosts and snows, or unprecedented heat, upon the comet? On this misty subject of cometary influence upon mundane affairs are the scientific any wiser than the unscientific?

I own that I have done my fair share of this questioning, and that I have been as free as anyone possibly could have been in putting these posers to astronomical and meteorological experts in various parts of the country. The astronomers, judging by their replies, have been too busy squinting into their telescopes or computing the mass of the comet, or figuring out the chemical constituents of its tail, to have looked about them for evidences of the physical effect of the erratic visitor upon this planet. They have been millions of miles away in interstellar space, and have hardly considered it worth while to look down upon the good gray earth and see what has been happening there. Some of the star-gazers who have essayed to reply to my questions have either denied the logic of my premises or have evaded the points set forth. Even so liberal a speculator upon astronomical subjects as Dr. Edward S. Holden, formerly director of the great Lick Observatory in California, replied: "I have nothing to say for publication on the possible effect of comets upon our earth as to weather, etc."

I have found the meteorological authorities as little given to speculation upon this highly important subject as the astronomers. Willis L. Moore, Chief of the United States Weather Bureau, wrote to me from Washington in May: "I beg to state that this bureau has no observations that would support a view that there is any such influence."

The question that most bothers all scientific investigators in this connection is, May not the comet have exerted a great magnetic influence upon the earth and may

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not that influence have been expressed in the abnormal meteorological conditions which certainly existed? Here is a field that few have explored and none fully, and yet nearly all the scientists are willing to admit that in it lie immense possibilities.

On searching the literature of the subject it will be found that few modern investigators have committed themselves to the theory of cometary influence of any sort upon the physical conditions of the earth or its atmosphere, and those who have done so are generally regarded as empiricists. But on the other hand I fail to find that any exhaustive or even fairly studious attempts have been made by scientific men of high rank in support of the hypothesis or against it.

If a layman who approaches the subject hat in hand, with great diffidence and with all due deference to the opinions of scientific investigators, may be permitted to make a suggestion, it is that too little attention has been paid to this important matter. For example, no one has taken the trouble to ascertain by thorough examination and comparison of meteorological records whether comets might have any relation to the weather or whether they might be in any way responsible for seismic disturbances. In referring to this subject, Prof. George Frederick Chambers, the well-known English writer upon astronomical phenomena, says, with an obvious sneer, that such an investigation might afford profitable occupation for those who are fond of "shooting the air."

Now I am not fond of shooting the air, but I will claim the same privilege as that enjoyed by the scientist speculating upon what I can lay hold of by way of physical fact. And my facts are not gathered from the misty realms of interstellar space, but from what has actually happened upon this solid and perfectly obvious planet. What study I have made of the records, though far from adequate, because the task is a tremendous one and should be undertaken by experts only, proves conclusively the fact that those years commonly known as "comet years" have invariably included seasons of phenomenal atmospheric disturbance and unseasonable weather. Abnormal heat and abnormal cold, abnormal drought and abnormal rainfall have been visited sporadically on the earth's surface during such years. There have also been great earthquakes, great wars and great disasters during those years. After making due allowance for the credulity of the superstitious in attributing these things directly to comets, may we who are not in the least superstitious be excused for attempting so to attribute them? With the testimony of the records at hand, it is not to be wondered at that the people of all ages have looked upon the approach of comets with dire misgivings and even with great dread.

We do not have to go away back to uncertain historical

records to prove that there have been phenomenal meteorological conditions in comet years. Take this present year 1910. Has it not already included enough scorching heat, of blighting frost, seasonable and unseasonable, and of high winds, rains and electric storms such as rarely have been witnessed during the past three or four hundred years, beyond which time the records grow dim? Before we proceed any further let us look at these recent conditions:

HEAD OF HALLEY'S COMET, FEBRUARY 11, 1836. From a drawing.

In the month of February, while the comet was faint in the sky, but driving toward this earth at the rate of fifteen thousand miles an hour, a great rainfall along the headwaters of the Seine raised that historic river to a mark unprecedented since the year 1658. The mighty waters burst through the dikes, flooded the Champs Elyseés and transformed Paris into a greater Venice. The gayety of the Parisians was dampened and chilled. Many of them fled from the city in fear. To get to their Chamber the Deputies had to go in boats. Never in the history of France was there a flood that did so much damage to property.

The next phenomenal condition occurred in America, where at many stations, all over the country, the highest temperature for March ever recorded officially was reached, the thermometer standing at 78 degrees in New York on three different days, and at 85 in Washington. The unseasonable warmth caused much illness along the Atlantic coast. In his report upon these abnormal conditions, Prof. F. H. Bigelow of the United States Weather Bureau says:

"For continued high temperature and deficient precipitation, March, 1910, established new records over many districts of the United States. Probably not within the recorded history of the country has there been a month of the same name with

such a long, unbroken series of successive days with the temperature above the normal and at the same time such a persistent absence of precipitation."

PHOTO BY PROF. E. E. BARNARD, YERKES OBSERVATORY.

THE COMET THE MORNING OF MAY 5, 1910.

In the latter part of April such tricks were played with the thermometer that those who read it could hardly believe their eyes. With freezing temperature in Louisiana, the sun blazed fiercely in the north, the thermal gauge registering 86 degrees above zero at Medicine Hat, in Saskatchewan. Equally torrid weather was reported from Newfoundland and Nova Scotia. At the same time a frightfully devastating frost damaged crops throughout the Middle West and the South to the extent of five hundred millions of dollars. In the extreme Southwest all April records were broken for high temperature, from Los Angeles 100 degrees being reported. While this was going on ten inches of snow fell in Michigan and there were other heavy falls in Illinois, Iowa and other near-by States.

Most extraordinary conditions were reported from other parts of the globe during the spring season. There was a terrific

typhoon in the East Indies and a cataclysmic upheaval in the waters of the Caribbean. The largest island of the Morant Keys disappeared beneath the surface of the sea, and steamer captains reported shoals of dead fish in that neighborhood. Then followed the flaring forth of Mount Etna and the devastation of Sicily, the fairest island of the Mediterranean. Fifteen of Etna's great craters vented blazing liquid to a great height in one day. The eruption burst forth with deafening thunders, likened by one correspondent to the simultaneous discharge of thousands of cannon.

CAPTAIN CHANDLER, U. S. A., ABOUT TO MAKE AN ASCENT FROM FORT OMAHA.

A cataclysm of even greater volume was that which occurred during the first week in May in Costa Rica, where the ground had been trembling for over a fortnight. On the night of the fourth of that month the cities of San José and Cartago were destroyed by a terrible earthquake and over one thousand people were killed. Beside this there were brilliant displays of the aurora borealis witnessed much farther south than is usual. Something, it is not yet known what, greatly interfered with the workings of the wire-

EXPERIMENTAL BALLOON FOR TESTING ATMOSPHERIC EFFECTS OF HALLEY'S COMET.

PHOTO BY PROF. E. E. BARNARD, YERKES OBSERVATORY.

THE COMET AS THE CAMERA SAW IT SEPTEMBER 16, 1909.
Two arrows indicate the comet.

less apparatus of ocean steamers. Several large meteors fell upon the earth, one of them, reported from El Paso, setting fire to a forest.

This is the record for the first five months of the comet year 1910—the year that is witnessing the return of Halley's brilliant astral visitor, which happens along this way once in about seventy-five years.

Now let us proceed backward along the line of historic comet Years. On March 17, 1906, Professor Ross discovered a comet. It was observed from the Lick Observatory in California for a month. On April 17th came the San Francisco earthquake. In the same year there was also a great earthquake in Chili.

Previous to our own remarkable comet year in which no less than three of these heavenly visitors have been observed, was that of 1882 in which Gould's comet was seen in bright sunlight in Europe and America. In the clear air of Colorado and Arizona it could be fol-

PHOTO BY PROF. E. E. BARNARD, YERKES OBSERVATORY.

ANOTHER EARLY PHOTO OF THE COMET.
Note change in position from that of September 16, above.

lowed without a telescope for several days. There were four comets that year and it was a year of most remarkable atmospheric disturbance, as well as bloodshed, for it witnessed the war of the British with Arabi Pasha's forces and the bloody battle of Tel-el-Kebir. All over the world unusual weather was reported and there were great storms and floods. Abnormal conditions prevailed throughout the United States, many stations reporting unseasonable heat and cold. At many of the Atlantic Coast stations the greatest rainfalls for January, April and September in forty years were reported, and all May records for low temperature were broken.

PHOTO BY PROF. E. E. BARNARD, YERKES OBSERVATORY.

POSITION ON SEPTEMBER 24.

PHOTO BY PROF. E. E. BARNARD, YERKES OBSERVATORY.

THE POINT REACHED SEPTEMBER 26.

Next we go back to Coggia's comet of 1874 during which year Spain was in the throes of the bloody Carlist war. In that country the comet was seen at its brightest. Abnormal weather conditions prevailed everywhere. In this country, beside the great storms, there were frightfully devastating frosts, and there was the lowest monthly mean temperature for April ever recorded. An immense meteorite fell

PHOTO BY PROF. E. E. BARNARD, YERKES OBSERVATORY.

BY FEBRUARY 3, THE COMET SHOWED IN THE CAMERA AS A BIG BLUR OF LIGHT.

in Turkey in May. On the night of August 9th, Prof. Daniel Kirkwood witnessed in Indiana the fall of 160 meteors in one hour.

Preceding this we have the comet of 1861, the brightest of the nineteenth century. Its coming was heralded as a token of the Civil war, and in 1862 there was a "second civil war comet" of a very peculiar appearance, with jets of flame flaring from its head. All over the world abnormal weather conditions prevailed during those years. The summer of 1861 was hot and dry to a degree almost unprecedented on the continent of Europe and particularly in Italy, which suffered greatly from drought.

While I do not purpose making this paper an historical one nor to cite too many examples of what Professor Chambers calls "shooting the air" I may be pardoned for referring back to 1811 and to the unusual meteorological conditions of that year, during which "Napoleon's Comet" blazed from the sky and continued to be visible for seventeen months. This was one of the hugest and most famous comets of the nineteenth century, and while it was lighting the heavens Napoleon Bonaparte invaded Russia after gathering together the greatest army ever assembled in Europe. This was a peculiarly hot year in England, France and Spain. In Portugal, where the summer was intensely warm, there was vinted the celebrated "comet wine" which, because of its excellence, commanded a very high price and was kept in the cellars of wealthy men for over sixty years, to be brought out on only great occasions. This vintage is declared by experts to have been the best ever produced in Europe. Its excellence was attributed to the phenomenal and unprecedented heat of that year, for "although the grapes were small, their quality was of the best."

Mr. Edwin Emerson, author of "A History of the Nineteenth Century," has published a book called "Comet Lore," in which he sets forth in detail the wars and catastrophes that have occurred during the comet years dating back as far as 1841, B. C. While much of the information contained in this book is, as to the earlier appearances of comets, necessarily vague, it will well repay the reader who cares to delve into the supposed effects of these erratic heavenly visitors upon mundane affairs. Mr. Emerson has gathered no meteorological data, and he informs me that he is not a believer in the influence of comets upon terrestrial conditions. But another recent writer on cometary lore, Mr. Edwin Fairfax Naulty, declares in an article published in *Collier's Weekly* that comets do cause local disturbances. "There has been and will be," writes Mr. Naulty, "unseasonable weather, auroral displays, magnetic disturbances and other phenomena; but these are not to be feared as involving the destruction of the human race or its planet."

When Mr. Naulty refers to "magnetic disturbances" he has probably put his finger, though perhaps unwittingly, upon the vital point of the whole matter of the influence of the comet upon the earth. In conversation with Prof. S. A. Mitchell of Columbia University, who has written several valuable papers on Halley's and other comets, I learned that that gentleman was committed to the theory that the tail of the comet is not so gaseous in its composition as electric, and this is the latest view of several other astronomers. From the enormous nucleus of the comet over 200,000 miles in diameter, or more than twenty times that of our earth, are emitted billions upon billions of those mysterious particles known as electrons, and these spreading out over hundreds of millions of square miles of space, might easily exert some sort of influence upon our earth, particularly by way of atmospheric disturbance. Should cometary influence be proved to be purely magnetic, then the abnormal heat and cold, violent winds and even earthquakes might be accounted for. The difficulty in the adaptation of this theory lies in the fact that dynamic meteorology is something of which we know as little as we do of the people of Mars.

What causes the changes in the weather? Professors of meteorology will glibly inform you that they are the result of peculiar distribution of barometric pressure. But what causes the peculiar distribution and to what extent is it affected by magnetic conditions they are unable to answer. Present day meteorologists are like certain species of jellyfish, groping about the abysses of the ocean floor to which they are confined. Little they know what is above that floor. It is time that they sought the surface.

Professor A. Lawrence Roth of the Blue Hill Meteorological Observatory says: "The methods employed in formulating weather forecasts are essentially those empirical rules which were adopted at the inception of the work." And again he remarks: "The cause of atmospheric electricity has always been an enigma to meteorologists, but the discovery of ions or electrons has thrown some light on this question."

Of late years the plan of sending up kites, so equipped as to register the thermal conditions at high altitudes, has been pursued by government observers, and a height of over 23,000 feet has been attained, but the results of this work have been futile thus far. To study the effects of Halley's comet upon our atmosphere the government sent up twenty balloons from Fort Omaha in May, but no report has been made up to this present writing.

James H. Scarr, District Weather Forecaster in New York, tells me that he believes the next great step in the science of meteorology will be in the field of magnetic influence upon our atmosphere, and this is the opinion of many other men in his line of work.

Plainly we are children in this branch of research, and the man who definitely promulgates the theory of the magnetic influence of comets upon the earth and brings any sort of proof to bear out his theory will be hailed as a great discoverer.

The discovery of Professor Arrhenius, the Swedish scientist, that the pressure of light emanating from the sun causes the tails of comets to stream away from it, as they invariably do, though smiled at when first announced, is now generally accepted. But it is still a great problem with astronomers as to what a comet's tail really is. Professor W. H. Pickering, along with some other students of the subject, declares that the tail is composed of gas. Prof. Harold Jacoby makes the astonishing statement that there is not more than one molecule of comet-tail gas to the cubic mile, which is equivalent to saying that on no account could there be the slightest effect from this gas upon our atmosphere. This one-molecule-to-a-mile theory has raised a laugh among the scientists, among whom, however, there is great dissension as to the elements of which a comet's tail is composed.

Flammarion's picture of the people of this planet being killed by the poisonous gases of a comet's appendage has been proved to be a purely fanciful one, as the great comet of 1882 passed within four thousand miles of the earth which must have been completely enveloped by the mysterious gas, electric field or whatever else it may be, and yet no one felt any direct effect, though that there was atmospheric disturbance of a high degree is argued from the fact of the abnormal weather of that year to which I have referred already in this article.

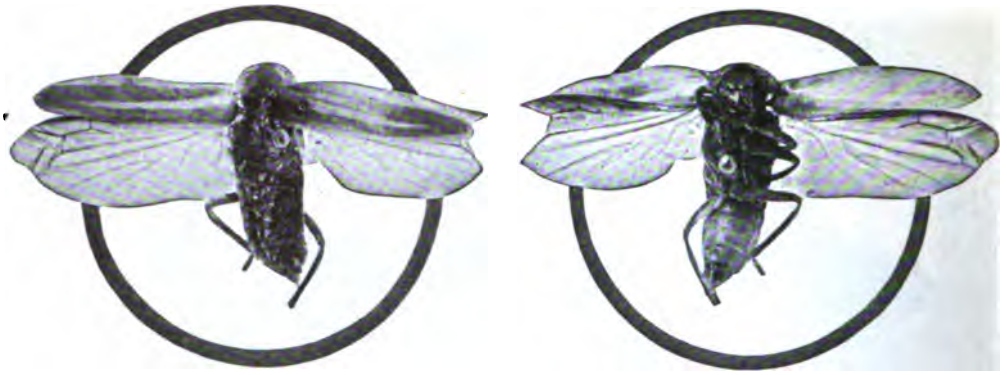
WHAT IS THE FIREFLY'S SECRET?

By

ROBERT A. SANBORN

ECONOMICALLY considered, the best artificial light of today is a spendthrift. It is a prodigal servant, and perhaps you never suspected. Take the example of the most modern illuminator, the mercury arc. Of all the energy distributed from the tube you get just 3.8 per cent. From the tungsten lamp, the next best, you are allowed but 1.3 per cent out of the total energy radiated. Out of the carbon glow lamp man draws but a beggarly .43 of one per cent. From the gas burner even less. Viewed then as an investment of physical energy our best light is as wild as the wildest wild-cat mining scheme. True, man gets what he asks, good lighting, but in the process of securing it he is imitating Nature at her worst, as a waster of tons of material to produce a speck. It is rather staggering to learn that while modern science has given us better light, that light is, from the standpoint of economy, but a very little more efficient than the sperm candle of our grandfathers.

Now let us see what Nature can do in this line when she really tries to be thrifty. Let us witness the vagrant sparkling of the firefly in the midsummer dusk, seeing, for the moment, not merely a spectacle of beauty but an illuminator of extraordinary efficiency. Consider this, that practically all the energy given forth by the firefly is in the form of light waves, and that of this light 96.5 per



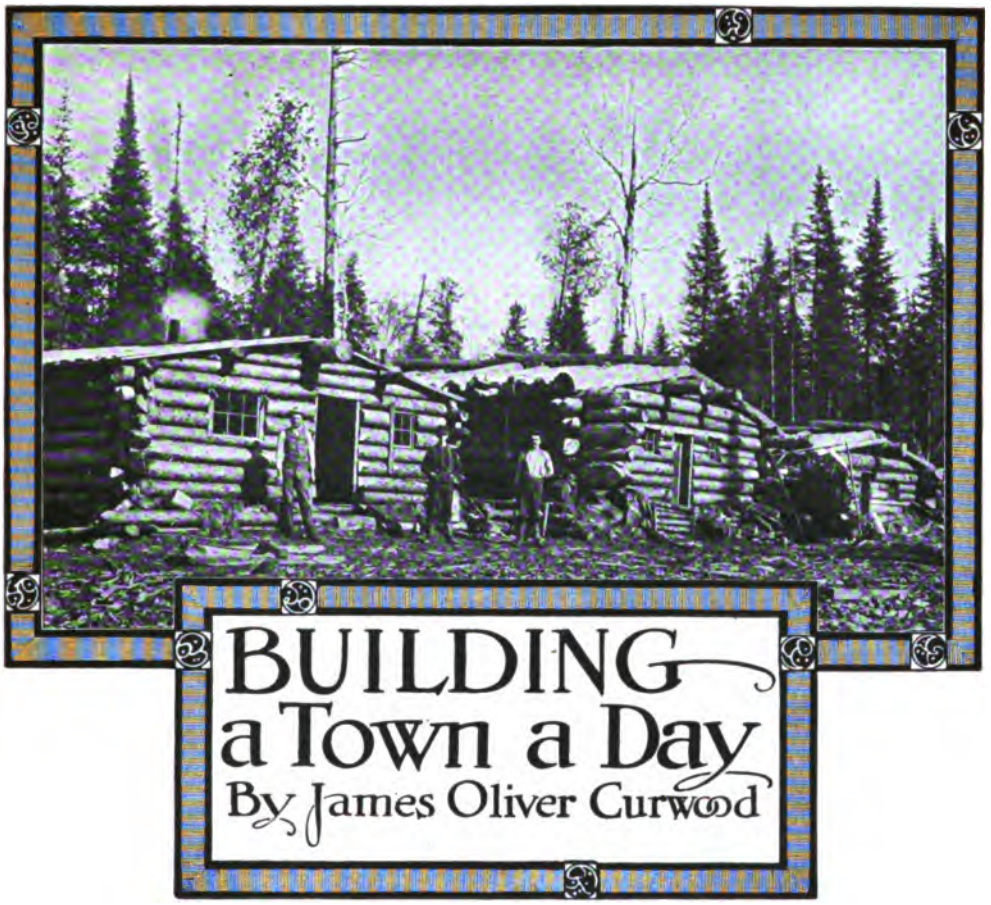
WHERE NATURE IS NOT PRODIGAL.
The light of the fireflies is of an extraordinary light efficiency.

cent is efficient to the eye. Though this light is so small that it would take 1,600 of the insects to equal the brilliancy of one candle, yet this should not diminish our respect for the firefly since in manufacturing his light he expends but *one ten-thousandth as much energy* as does the candle in producing an equal quantity of radiance. More than this, the firefly would have to expend 99 times as much energy as he does to bring his light to as low a point of efficiency as our best.

The question to be solved is, what is the composition of the light-giving material in the firefly? Although, it has been demonstrated that an electric current quickens the firefly light, though he flourishes in the sultry months and is gayest in sultry places when and where there is much free electricity in the air, yet it is hardly probable that the insect has the function of an electric battery. He is certainly not incandescent since his substance could not comfortably endure the temperature of 2,000° Fahr. which our incandescent materials require. His light, answers the biologist, is simply the product of the combustion of oxygen and carbon compounds, such as commonly goes on in all material substances. Only here the combustion is of such a nature that instead of merely radiating the waves of animal heat as is usual, there is a rapid vibration caused in the surrounding ether, producing the waves to which our visual organs are sensitive. In his case Nature desires nothing but light and produces this with the least possible waste.

It remained for a Japanese biologist, S. Watase, to present most plausibly and clearly a theory as to what goes on in the light-giving cell of the firefly. He describes the contents of the cell as a fatty substance, consisting of yellowish, white granules. This, he concludes, is a waste product cast off in the growing process of the living tissues of the insect. Now instead of the usual excretory channels Nature, for an unknown reason, has provided the insect with a system of capillaries that, investing and connecting with the cell, bring into it from the outside air, oxygen, to burn up this dead material. And because of the peculiar chemical composition of this waste product the bon-fire that happens when oxygen mixes with it yields all light and no heat. It would be distinctly worth man's while to learn just how to build this kind of a bon-fire.

When he does know, as he surely will when he buckles down to the problem, he will perhaps contrive to go the bug one better, in producing a light of more efficient color than the intense green of the native firefly. The last analysis is then waiting action by the physiological chemist. Professor Langley has written: "Nothing forbids us to suppose that it —the firefly light—may one day be produced by some process of the laboratory or manufactory." And more than one scientist is making the attempt.



BUILDING a Town a Day

By James Oliver Curwood

IT is expected that the next eighteen months will see the culmination of one of the greatest colonization movements in history, for during that time it is schemed to build and populate 220 towns in the Dominion of Canada, an average of one town for every other week day in that year and a half! By the middle of 1911, if Canadian government officials are not wrong in their estimate, these 220 towns will have their official places and names on the map of Canada, populations of from one hundred to a thousand people each, and they will have been made largely by good American citizens from over the border.

Never has a more interesting or a more unusual scheme for the development of a country been undertaken than this, and that it will undoubtedly succeed is assured by the fact that both the Government and the great Railroad interests of the Dominion are behind it. Recently Andrew D. Davidson, one of the big men of the Canadian Northern, said to me, "I will show you how towns and cities are born, as they have never been born in any country in the world before; I will show you how within a year or two a vast wilderness, a thousand miles in width, is to be populated, so that from one town you will almost be able to see the smoke of the next."

And he did. Today the greatest railroad building epoch in the history of any country is in progress in Canada, notwithstanding that she already has more mileage according to population than any other nation on earth. Nine thousand miles are projected or under construction. The new Grand Trunk Pacific is stretching from coast to coast. The Canadian Pacific is throwing out

HON. FRANK OLIVER, MINISTER OF THE INTERIOR.
Head of the Immigration Department of the Dominion.

lines right and left. The Canadian Northern has 5,000 miles and will soon have 3,000 more. I followed construction gangs into the unbroken wilderness of the north, and into the mountains of the west, ate moose meat with the railroad builders and chatted with the factors of Hudson Bay Posts, and I found railroads penetrating everywhere. But the most wonderful thing that I found was the great scheme of the Government and the Railroads, which is already in operation, for the building and populating of these 220 towns. This scheme is hardly known in the Dominion itself. It has not been exploited, for good reasons which the Government and the Railroads have kept to themselves.

On the new Grand Trunk Pacific westward from Winnipeg, a distance of 960 miles, a new town is to be located during the next year and a half at a distance of every eight miles, or 120 towns for the total distance. Most of these towns are already marked on the construction maps and the majority of them are named. On the mountain division of the same road, which is to terminate at Prince Rupert on the Pacific, thirty-five new towns are to be platted. On the main line and branches of the Canadian Northern in Saskatchewan and Alberta thirty new towns are to be brought into existence, and on the Canadian Pacific in the same provinces thirty-five, a total of 220 in all!

M. V. MACINNES, CHIEF AGENT OF THE IMMIGRATION FORCES AT WORK IN THE UNITED STATES.

The history of these towns is to be unlike that of any other in existence. They are not to be merely platted and named, and then left to vegetate. They are to be forced into life. That is the remarkable thing about them. And this is neither a guess nor a hope. It is the result of a "game of town-building" which has been played out by the Government as carefully as one might play a game of chess.

It must be understood, from the first, that in Canada the Government and the Railroads work hand in hand; so much so, in fact, that the Government is building a half of the new transcontinental—the Grand Trunk Pacific. Each of these 220 towns is to be located in a fertile farming region or in a country abounding in mineral and timber wealth. Otherwise the scheme would fail. One hundred and seventy-five of them are to be in a farming country. At the very first, as the towns are officially platted, a station is to be built at each place; not a very large one, but a station for all that. The elevator companies of Canada have agreed to build at least one elevator at every station, and construction on many of these will actually begin before there is a farmer in the neighborhood.

This is the first step in the populating

THE GRAIN ELEVATORS OFTEN FORM THE NUCLEUS OF A TOWN.

WHERE A TOWN PRECEDED A RAILROAD.
This little settlement was in existence when the tracks were still fifty miles away.

of the new towns. It is argued that where there is a station and an elevator farmers will gather, but the scheme does not wait upon the will and choice of the incoming settlers. Hereafter, to a very large extent, the tide of immigration is to be directed in channels especially cut out for it. "Into this valley," say the Government and the Railroad, "we will throw 100,000 people within the next two years. We will bring another hundred thousand to the lumber and minerals of British Columbia within three years. Here is a town, with a thousand square miles of wheat land about it, that we will start with two elevators instead of one, and to which we will throw 2,000 people within eighteen months." And so, in this way, the scheme has been carefully mapped out. The army of 300 Canadian agents who are working almost night and day for settlers in the United States are already beginning to receive their instructions for the settling of these places. In England, Scotland, Ireland and other European countries the same scheme is to be followed out.

Here is the way it works.

W. J. WHITE, INSPECTOR GENERAL OF CANADA.

A farmer, with a couple of husky sons, wants to emigrate to the Canadian farmlands. He wants free homesteads. Consequently he must go to one of these Canadian agents. That, in short, means another citizen for one of these 220 towns, or its adjacent territory. He is easily "booked" for one of these new stations. When he reaches his destination he is met by an agent, who takes him in hand, and because he and his sons are each getting a big farm for nothing they can be placed almost where the agent wants to place them, so long as they are getting good land. If necessary, seventy per cent of the emigration of the next twelve months can be handled in this way. If the Government and the Railroads want to place 1,000 people in and near a certain station within a given time they can do so. For the first season in some of these new towns the elevators will probably do no business; but with the second season the crops will begin coming in. That is the guarantee on which the companies erect their buildings.

This is not all of the scheme for the building of these 220 towns in a year. Most of the Americans, of course, will settle on the farm lands. But a certain percentage of them, and of other people, will be induced to remain in the towns. Both the Government and the Railroads will offer inducements to capital, and there is plenty of capital besides that held by the elevator companies which is waiting for just such inducements. Capital, it is

W. D. SCOTT, SUPERINTENDENT OF IMMIGRATION.
The actual working head of all immigration.

IMMIGRANTS BOUND FOR THE REGIONS WHERE THE TOWNS ARE IN BUILDING.

schemed, will immediately bring industry, and people.

That this scheme of building towns is practical has already been demonstrated, though but few know of this demonstration. It was tried out in that immensely fertile region on the Canadian Northern between Lumsden and Saskatoon, a distance of 160 miles. When I went over this region just seven years ago there were only three settlers between these two towns. Now there are

AN ABANDONED CAMP OF THE TOWN BUILDERS.

BREAKING GROUND ON THE VIRGIN PRAIRIE.

ten towns, not including Lumsden or Saskatoon, with a population of 10,000. There are, in addition, 25,000 settlers in the vicinity of these towns, and last year they had five hundred thousand acres of wheat land under cultivation. Ninety per cent of these settlers and townspeople are Americans and are true pioneers.

This was only a partial experiment; that is, it was not prosecuted with the push and determination that will characterize the new scheme of town-building, and also less than a third as many

A COOKING CAMP—THROUGH JUST SUCH COUNTRY THE NEW ROADS ARE BEING RUSHED.

THE HOME OF THE ENGINEERS IN THE WILDERNESS.

people were going into the Canadian West at that time as now.

Early next year, because of these new towns, the Department of the Interior of Canada will issue new maps of the Dominion.

In a recent interview Col. A. D. Davidson, of the Canadian Northern, said to me, "To the people of the United States must almost directly be given the credit of building the great railroads of Western Canada. We have banked on them, and we bank on them still. Not only have they built our railroads, but our towns. They are pouring into our West as never before. It is not the poor and destitute that come, but the best among the people of your country; men with ambition, with energy, and in most instances with modern machinery and up-to-date ideas. Your Americans are the best farmers in the world. We bow to them as the real builders of the prosperity of the Canadian West."

In this way does it come about that Americans will build a town every other day, resting on Sundays, during the next year and a half.

BARGAIN IN COLLEGE EDUCATION

By

RALPH BERGENGREN

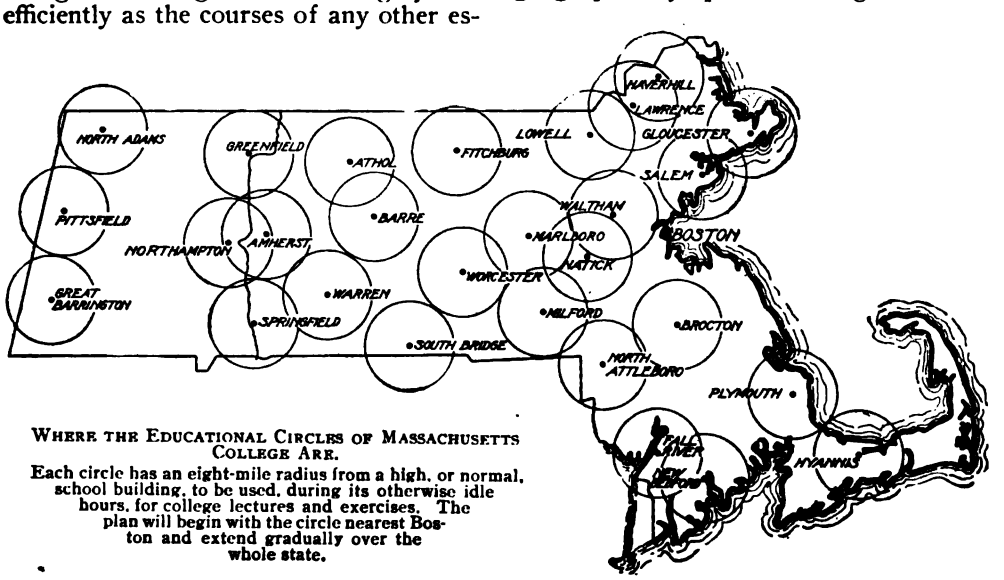
Massachusetts College has newly incorporated plans to divide an entire state into educational centers and thus offer college education at a nominal tuition fee to the people, who will now be able to attend its courses without going away from home. This is a new idea in education that will more than double the usefulness of high and normal school buildings and provide a low cost college course for all the residents of the state without lowering the established standards of scholarships.

EVERY state in the Union has in operation a large and expensive educational plant of high and normal school buildings which are in use not more than five hours every day for five days in the week and therefore exhaust not more than forty per cent. of their possible working efficiency.

Every state has also a large and constant number of young men and women who are debarred from the colleges either because they cannot afford the expense of a college education or because circumstances make it out of the question for them to leave home for that purpose.

But if these high and normal school buildings, when not in use for their own department of education, were devoted to college courses, given as thoroughly and efficiently as the courses of any other established institution of learning, would not the whole great problem of educational opportunity for all the people be greatly simplified, the educational plant of the state worked to its logical capacity, and a college education literally brought within reach of those who cannot leave their homes to go in search of it?

This question, which rather reverses the ancient story of Mahomet and the mountain, represents an entirely new idea in education. It is to be tried out in Massachusetts, beginning on a comparatively small scale next autumn, and will undoubtedly be tried out thoroughly. Whether or not this remarkable project proves successful in the long run, Massachusetts College, recently incorporated by the legislature of that state, will be geographically quite the largest educa-



WHERE THE EDUCATIONAL CIRCLES OF MASSACHUSETTS COLLEGE ARE.
Each circle has an eight-mile radius from a high, or normal, school building, to be used, during its otherwise idle hours, for college lectures and exercises. The plan will begin with the circle nearest Boston and extend gradually over the whole state.

SOMERVILLE HIGH SCHOOL.
This is one of the first buildings that will be used by the Massachusetts College.

tional institution in the world, for it will apply the traditional arrangement of an English university, like Cambridge or Oxford, not to a single university town but to the entire state of Massachusetts. Its plant will be the high and normal school buildings already standing in some twenty-eight Massachusetts towns and cities, and ninety per cent. of the population will thus be situated within an eight-mile radius of one or other of the Massachusetts College lecture rooms and laboratories. Although the college will open with only a fraction of its possible equipment the interest and co-operation already assured throughout the state indicate a rapid development of all the proposed educational centers.

Unlike any previous effort to expand the influence of collegiate education, Massachusetts College proposes to stand on its own feet, a homogeneous and self-respecting institution with a faculty that will compare favorably with that of any other college, with courses equivalent, in time, labor, and the demand made upon the student, to those of any of the established colleges, and with an A. B. degree that shall represent an equal amount of scholarly attainment. The name "college" has been criticised in this connection and the suggestion made that "university" would be more exactly descriptive. In the opinion of the founders, however, the word "university," which means in England a group of colleges, has come in this country to mean a college plus professional schools—as in the case of Harvard and Yale—whereas the new Massachusetts institution is literally a college without them. It will provide the collegiate degree of A. B. which the better class of professional schools are coming more and more to demand as an entrance requirement. It will provide opportunity for high-school graduates and others to continue studies in which they are interested either as special students or as part of the four years work necessary for the degree. It will

give public school teachers throughout the state an opportunity to increase the measure of their own knowledge which is now only partly supplied by the short sessions of the summer schools conducted by the older universities. And it expects also to prepare students for entrance into the upper classes of these older institutions and to assist them in meeting the greatly increased expense of tuition and college residence. The possible usefulness of this "real college" within reach of practically everybody in Massachusetts extends in more directions than can here be enumerated. And the confidence of the promoters in the success of the venture rests upon the fact that the needs it is designed to meet are fundamental and evident.

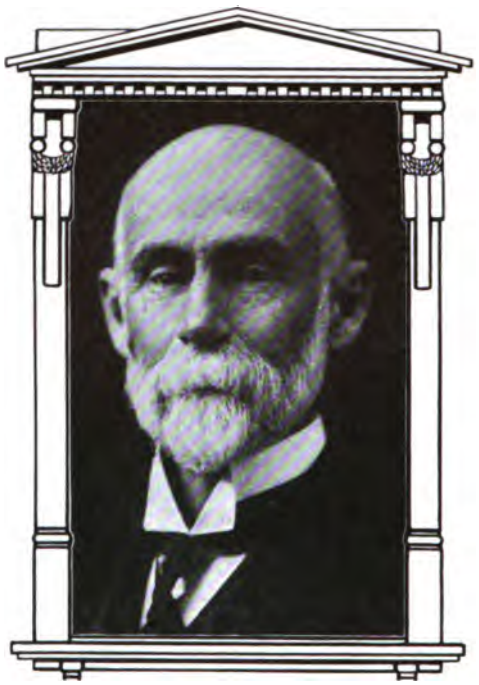
As the institution now stands, Massachusetts College is the bringing to a focus of several educational trends all pointing on the one hand to the growing desire for collegiate education and on the other to the growing belief among educators that the educational facilities of the existing colleges are by no means necessarily limited by the boundaries of a campus.

JAMES HARDY ROPES, DEAN OF THE DEPARTMENT OF UNIVERSITY EXTENSION, HARVARD UNIVERSITY.
A probable trustee of the new educational plan.

EDMUND D. BARBOUR, ONE OF THE TRUSTEES OF MASSACHUSETTS COLLEGE.
Projector of the new idea in education.

Wherever opportunity has been given the public to listen to college lectures and to follow in a systematic way the instruction given in college courses—as, for example, in the courses opened to the people within a convenient radius of Providence, R. I., by the authorities of Brown University; in the work of a similar nature carried on by the Lowell collegiate courses in Boston; or in the evening courses provided in many cities by the Young Men's Christian Associations—the public has responded by showing an immediate interest. Wherever, in short, young people who could not "go to college" have been given opportunity to get for themselves some small fraction of college education, the results have shown that the opportunity was appreciated.

But so long as these efforts remain merely a by-product of institutional activity instead of being the main purpose of it, the results must necessarily be inadequate and unsatisfactory. Existing colleges cannot, except to a limited extent, allow their teachers to assume outside duties. The free tuition of a state university is no assistance to those whose circumstances will not permit residence



GEORGE H. MARTIN, TRUSTEE OF MASSACHUSETTS COLLEGE, AND SECRETARY OF THE STATE BOARD OF EDUCATION.

in or near the town where such a university is located—and the wisdom of absolutely free tuition is by no means universally admitted by those whose life work is the study of educational matters. What is given away is rarely if ever as valuable to the recipient as what has to be worked for, and by no means the least important feature in the plans of Massachusetts College is the existence of a tuition fee that will help support it and at the same time reduce the necessary expense of its students to not more than twenty-five per cent. of the minimum tuition at any of the established colleges. At the very lowest it has been estimated that a young man can go through four years of college residence for $1,600—and to anyone familiar with American college life this minimum figure stands for heroic self-denial and often positive suffering. At Massachusetts College the average yearly tuition will be $42.25—and against the cost of residence in a college town the incidental expenses will be limited to car fares and the purchase of text books and stationery. A ten cent car fare represents the greatest distance that ninety-eight per cent. of the students will be from the nearest college building and the division of the entire state into educational centers with an eight-mile radius will eventually make it possible for a student who moves from one part of the state to another to take up his studies uninterrupted in his new neighborhood.

The principle, broadly speaking, is that of the three-ring circus which developed naturally out of the increasing size of circus audiences until all the people who wanted to see the circus could no longer be gathered conveniently around a single arena. Although there are three rings under the same canvas, practically the same kind of performance is going on in each of them; practically, there are three audiences at three circuses. The figure may not be altogether dignified as applied to an educational institution but it is fairly descriptive; except that Massachusetts College will have twenty-eight rings and twenty-eight almost simultaneous performances.

But how are these performances to be managed? Like many another project

WILLIAM ORR, TRUSTEE OF THE NEW COLLEGE. Also principal of the Central High School, Springfield, Massachusetts.

that has taken years of preliminary study, the final working out of the plan seems surprisingly simple—and practically every school board in the state, every high and normal school principal, every superintendent of schools, and every college president has expressed the belief that it will work successfully. Lectures are to be given by a corps of traveling lecturers—men who will spend an hour on the train in order to spend an hour on the lecture platform. The state, already divided into the twenty-eight educational centers of Massachusetts College, is again divided into three larger circles whose radius may be measured by an hour of railway travel, and the necessary teaching force in this department must include three sets of lectures covering respectively the territory represented by each of these larger circles. To supplement these traveling lecturers, each of the twenty-eight centers must have its own force of resident teachers to conduct the routine work of recitation, exercises, consultations, and examinations. And the older colleges of the state will in all likelihood add to the educational equipment of their youngest colleague by allowing members of their own faculties to give occasional lectures at the different centers.

SALEM HIGH SCHOOL.
Where an educational center will be opened in the autumn.

The important thing, however, is that these traveling lecturers are to belong to the regular staff of the institution for which they lecture, and that Massachusetts College, in the selection of these and all its other officials, will be in the market in direct competition with other institutions of learning the world over. In bringing the college to the people, here, for the first time that such a plan has ever been formulated, the standard of the college is to be in no wise lowered or popularized. It is the intention of the college to make its degree as valuable as that of any other, and to bring its students into as direct contact with the men who instruct them. Both young men and young women will be admitted to registration, the necessary qualification being either the high-school certificate or proof that the candidate can do the work required by the college. Obviously the "social side" of college life that comes naturally from the residence of many students in the dormitories of a single college is not expected to play much part in a plan covering so wide a territory, yet it is within the bounds of possibility that each center may develop something of the class feeling that comes from daily college association, even as each separate college in an English university group becomes distinctively characteristic and a competitor with all the other colleges both in games and scholarship.

Such is the plan developed by Mr. Edmund D. Barbour, a retired Boston merchant, in consultation with many important educators and now launched as a private corporation asking only the cooperation of the different towns and cities in furnishing buildings, light, heat, and janitor service during the hours when this valuable property would other-

LYNN HIGH SCHOOL—ANOTHER OF THE PROPOSED NEW EDUCATIONAL CENTERS.

wise be idle. It may be said that the plan has been welcomed in proportion as it has been fully comprehended: that the opinion of Massachusetts educators is practically unanimous in believing that the institution is needed and that it will succeed: and that the project is already sufficiently capitalized to insure a completely adequate beginning. No state aid has been asked, and although more funds will be needed to carry the scheme to its complete expression neither Mr. Barbour nor his associates are seriously disturbed by the fear that a financial backing will not develop. Again, unlike the typical American educational project, there is no wish on the part of the founders to discover a financial "angel" who at one fell swoop will spread his wings over the entire undertaking. Rather it is considered the more wholesome development for each center to provide its own endowment, the income to be used in part to send such advanced students as give evidence of exceptional ability to the older colleges for a year or more of college residence. The value, in the sum total of educational influence, that is derived from the atmosphere of an established college with its traditions and its opportunity for college acquaintanceship is by no means denied or minimized in the attitude of Massachusetts College.

There is no question of private profit. The fees for tuition are expected to pay no more than the running expenses. The income of the college from tuition, gifts, etc., is expected to more than pay the cost of the courses given in the college buildings, and this surplus is to be used in aiding students of especial ability and restricted means to complete their college education by a year or more of residence at one of the older universities.

This, however, is not looked upon as philanthropy. The theory of the college is that its students are much more wholesomely benefited by the opportunity to attend its courses at the minimum tuition than by providing such courses without any charge whatever, but that the student who has paid his or her way for

three years at the college is then in a position to be legitimately and self-respectingly assisted in meeting the heavier expense of a year's residence at one of the older institutions.

Mr. Barbour gave $100,000 to start the endowment. It is his conviction that a sound growth of such an institution depends upon its appeal to a great many donors and the college is capitalized by an increasing number of individual gifts.

The standing of the college is very well indicated by the list of trustees: Edmund D. Barbour; George H. Martin, Secretary State Board of Education; William Orr, Principal Central High School, Springfield, Mass.; Paul H. Hanus, Professor of Education, Harvard; Thomas A. Jaggar, Jr., Head of Department of Geology, Massachusetts Institute of Technology; Stratton D. Brooks, Superintendent Public Schools, Boston; Courtenay Crocker, lawyer and educator. John Hardy Ropes, Dean of Department of University Extension, Harvard, is not at this writing a trustee, but will probably be elected in the near future.

STRATTON D. BROOKS, SUPERINTENDENT OF PUBLIC SCHOOLS, BOSTON.
Chosen a trustee of Massachusetts College.

COURTENAY CROCKER, A LAWYER WHO HAS BEEN CALLED IN AS TRUSTEE.

But it is also realized by the older colleges themselves that the students likely to come to them from the new institution must of necessity be unusually promising material. They stand to gain rather than lose by an experiment that at first sight looks like dangerous competition. For this competition, despite the modest tuition of Massachusetts College and its determination to maintain a high collegiate standard of instruction, is really negligable. The freshman classes of the new college must inevitably be drawn from candidates who would otherwise be unable to attend any college whatever, and is therefore likely to have little or no effect on the freshman classes of the older institutions. But the experience of every college shows a diminution in numbers as the classes approach graduation. The Senior class is smaller than the Junior class, and the Junior class, in turn, very much smaller than it was when its members entered as freshmen. To have this diminution of its own classes met in the long run by the entrance into those same classes of advanced students from Massachusetts College means for the older college a very decided gain both in

HAVERHILL HIGH SCHOOL.
The third institution in Massachusetts College list of branch schools.

the number and individual ability of its students.

The curriculum will include English, Ancient and Modern Languages, History, Economics, Government, Science and Mathematics, with a subordinate group of studies including the Fine Arts, Education, Psychology, Ethics, and Philosophy. These subjects may be studied as special courses without counting toward the degree of A. B., the fee in this case being $5.00 for each term subject. The regular four years course, costing $169 for tuition and terminating with the A. B. degree, will require regular attendance at lectures, recitations and other exercises equivalent to the prescribed work of any other college, and the degree will be awarded only after similar tests of scholarship. In a majority of cases it may be frankly admitted that the student who holds a degree from Massachusetts College will have worked harder and have actually more to show for it than the average graduate of the average college. In the Board of Advisers provided by the charter of the new institution there will be representatives from various Eastern centers of learning of Harvard, Boston, and Clark Universities; Amherst, Boston, Clark, Massachusetts Agricultural, Mount Holyoke, Holy Cross, Radcliffe, Simmons, Tufts, Wellesley, and Williams Colleges; Massachusetts Institute of Technology and Worcester Polytechnic Institute.

With a million dollars already secured out of the three millions which is considered necessary to establish the new college throughout the state, a beginning will be made next autumn with the northeastern group of educational centers. From this beginning there seems no reason to doubt that the other centers will be rapidly developed, and that Massachusetts will here set an example that other states will find it to their advantage to follow.

A Match

If love were what the rose is,
And I were like the leaf,
Our lives would grow together,
In sad or singing weather,
Blown fields or flowerful closes,
Green pleasure or gray grief;
If love were what the rose is,
And I were like the leaf.

—SWINBURNE.

THE TRUTH ABOUT CONCRETE

By

BENJAMIN BROOKS

WHETHER this be an age of concrete or a spasm of concrete, the fact remains that the mechanical arts have never before been so suddenly jolted out of their old routine and sharply twisted into conformity with a new material of construction. Municipal laws, building ordinances, college courses, text books, trades and professions have been turned wrong side out and made over all on account of this new concrete. An engineer may hardly venture to leave his researches long enough for a short nap without danger of finding himself out of date when he wakes. A generation ago we were content to use concrete as the Romans did—in masses only. A decade ago we began pouring it into what were then miraculously thin walls and floors for buildings—yesterday we talked of spanning the Hudson River with a concrete bridge. Today we make railroad

RUINS OF PHILADELPHIA CONCRETE WAREHOUSE THAT FELL WHEN NEARLY FINISHED.

COLLAPSED CONCRETE ROOF.
Ruins of Scott Building, San Francisco, after earthquake and fire.

ties, rail fences and telegraph poles out of it; and tomorrow small boys will no doubt be flying concrete kites. This is going quite some.

But, on the principle that a new girl in a candy shop can always be counted on to make herself sick on candy and follow up her first enthusiasm for it by a temporary revulsion, it would be very odd if this great and sudden enthusiasm over an attractive new addition to the mechanical arts should not be followed up by a sharp reaction; and such, I believe, has already begun to set in. Men of my acquaintance who are not engineers, knowing that I have both designed and built things of reinforced concrete, make very insinuating comments on it for my especial benefit. "I don't think so much of it as I did," says one. "I paid five thousand dollars for a concrete cellar and now it isn't water tight. You'll have to show me where it is such wonderful stuff." "Were you," says another, "with the X and Y Company when they built the concrete pier at Clamshell-by-the-Sea? The Aldermen are going to investigate them. Rotten concrete, they say; no better than chalk. The town furnished the cement, too. I can't see what object the company had in not putting it in. Ha! Ha! You concrete fellows are a rum lot." A third asks confidentially, "On the level, now, if the A B C Company's new building *isn't cracking* why do they need to coat it with that asphaltum weather proofing?" Any day I am likely to be handed just this sort of thing and I am forced to admit I don't always know a good answer to make.

When one resolves to pocket his prejudices, look the matter over scientifically and read the chapter of concrete accidents through, he sees easily enough from the great variety of failures, the great number of them and the peculiarly involved and mysterious manner in which many of them occur, that the concrete kickers have a very good case. I trust we may cite a few for the sake of illustration without doing particular vio-

lence to the feelings of anybody in particular.

A wealthy manufactory—one of the best known in the country, one that prides itself on its model shops, its broad-minded treatment of its workers and the excellent photographic paraphernalia which it sells all over the known world—attempted to erect a concrete building. The building, however, fell down. The coroner, upon investigating causes for the accident, found that certain columns of the structure were of very crumbly concrete in spots, that they were weakened by the admixture of sticks and sawdust, that the reinforcing bars were in some cases of the wrong kind, in other cases wrongly placed, and in still other cases, omitted entirely. He accused the building contractors of criminal carelessness for furnishing building plans not in accordance with specifications; he accused their constructing foreman of criminal carelessness for leaving in sawdust and leaving out steel, and the owners' representative of the same criminal carelessness for not being on the spot with his eyes and his wits about him. Doesn't it seem strange that a great company who could do everything else so well should be outdone by human niggardliness and carelessness in this seemingly simple undertaking of a concrete building? But I recall an accident in a building where nobody was guilty of any such thing. On the contrary, the builders had gratuitously enriched the concrete in the lower part of a main girder to give a better safety factor. But the girder failed all the same. Apparently the extra rich concrete failed in some mysterious manner to unite with the standard mixture above it, thus leaving a line of cleavage.

Turning next to some curious accidents to piers and breakwaters, we find even the United States government occasionally meets with concrete disasters. The Bureau of Yards and Docks, using their greatest care and the finest materials, built a concrete bulkhead around the Charlestown Navy Yard in Boston Harbor. In about seven years it was almost a total wreck. Some engineers said it was frost, but the bureau wisely ventured no hap-hazard explanation. In the harbor of Baltimore was built a pier with expensive concrete piling under it. And now the piling begins to be eroded or rotted just at the water's edge. This time the experts ventured that it might be city sewage or floating ice. In my own mind I am satisfied that neither frost nor ice nor sewage worked this havoc for I have seen concrete piers placed with the greatest care in water where frost and sewage never were known, which nevertheless after five years, a chicken could eat with a relish.

RUINED CONCRETE WAREHOUSE.
Wreck wrought probably by wrong mixtures in a Philadelphia building.

CONCRETE CHIMNEY THAT FAILED.
Two workmen lost their lives in the fall of this piece of work at South Royalston, Massachusetts.

Turning from the influence of salt water to the inland, we find one of the principal uses of concrete is for drains and sewers. It seems an admirable material for such purposes—easily formed to any shape or size, and very cheap. Yet when the tile interests—the arch enemies of concrete sewers—wrote inquiries here and there as to how concrete sewers were holding out, they received answers from several laboratories and universities of standing, from Chicago, Ill., Paterson, N. J., Springfield, Mass., Portland, Me., Memphis, Tenn., —about a dozen principal cities in all—to the effect that concrete sewers were a dismal failure. A few years underground and the sewer acids and sewer gases reduced them to crumbling wrecks. So much for sewers; but even in the case of clean irrigating water we are not free from disaster. For in the Shoshone and Sun River projects the Reclamation Service, despite its well earned reputation for doing good work, found after a few years that certain concrete drains which they had laid with great care were reduced to streaks of sand.

Then we have accidents from cold weather—a long string of them not worth citing and two very peculiar ones which are. One is the failure of an arched filtration chamber in Lawrence, Mass., which seemed never to have hardened properly although it was covered with manure in the proper manner to warm it and shield it from the frost. The other is the strange disintegration of the floors of a building which was built in midwinter but carefully surrounded by canvas and kept warm within by charcoal fires. It can be proved that frost never touched these floors and yet—

Finally we arrive at the failures by fire. It is not necessary to catalogue them. After the Baltimore fire accounts appeared in insurance mazagines of how concrete floors were shoveled out of the windows and down chutes like so much crumbled plaster. Columns and beams were disintegrated or transformed by the heat into a chalky powder for varying distances from their surfaces according to the degree of heat. After the San Francisco fire photographs appeared showing concrete in heaps and reinforcing bars bulged and twisted into ruin. This in spite of the fact that concrete is vociferously advertised as a thoroughly fire-proof material.

"But," says the reader, "in these same fires and under similar conditions other materials suffered also. If your concrete

CONCRETE PIPE CRUMBLED UNDER ACIDS.

seawalls had been built of wood you would have fared no better." Exactly! We have indeed, failures in all building materials. Tile fire-proofing cracks, brick chimneys crumble, wooden buildings burn, steel bridges collapse, stone campaniles fall, and if failures in other materials seem not so frequent or so involved in mystery as failures in concrete, that is still not the main point. So little thanks or distinction is to be got from the mere writing of disparagements — a job for any smith's apprentice with a hammer — that the discerning reader will easily begin to suspect me of having some other more worthy object in view.

CONCRETE PIPE THAT WENT TO PIECES.
Acids of sewers eat the life out of some mixtures.

My object, far from being a mere knock or even an unfavorable comparison, is, in fact, to show that the general popular conception of the modern reinforced concrete is quite wrong; that we have not looked at it from the right angle; that we misuse it, misunderstand it, subject it to great injustice and then blame it instead of ourselves.

We bank, for instance, on the much advertised statement that concrete is absolutely fireproof. But a moment's thought will show anyone that it cannot be; for it is known to contain in its crystalline construction a certain necessary quantity of water which, when subjected to sufficient heat, must turn to steam and explode just as the water in salt crystals snaps and cracks when they are thrown on a hot fire. After reaching about 600 degrees Fahrenheit, concrete surfaces begin to lose this water and to crumble; and it would seem only common sense to provide against this by imbedding the reinforcing rods something more than the customary scant inch so that in a prolonged conflagration they would not become exposed and warp and bulge, thus destroying the whole structure. Either this or arrange building laws, fire regulations, taxes and penalties in such a way that a fine group of concrete buildings would not have to stand and be roasted to a white heat by the burning of a surrounding mass of wooden shacks. Granite of the everlasting hills is fire-proof also, but it would never stand that; and it seems a trifle egotistical to expect a home made substance of our own to stand it, however well advertised it may be.

In the case of concrete sewers we seem to be quite as unreasonable and quite as disappointed. For since all sewers must reek with acids and since these acids are known to have a marked effect on lime, and since, further, cement contains a large per cent. of lime, it should not require more than a Shakespearean imagination to foresee what would happen to an acid-bearing concrete sewer. Little imagination is expended, however, in this line and little science in proportion to the money spent. The specifications and building regulations are more often copied from one city to another, mistakes and all, without much study or investigation.

Other forms of concrete failures—the wrecked bulkheads and irrigating ditches —seem to be rather more involved, giving us more excuse for having made mistakes in those directions but capable of explanation and prevention all the

same, as we shall see later. But the most flagrant mistake of all, which works the greatest injustice upon our new building material, is regarding concrete design and concrete construction as a simple, easy matter that any unskilled laborer with a shovel can accomplish. It looks simple when you see it flowing into forms so easily and rapidly. It even feels easy when you do it. Only after your work has had time and trial to show its weak points do you begin to see how difficult it is to do well. And it will take some space and a lot of dry explanation to dispel the idea here.

FAILURE OF CONCRETE IN A RAILWAY BRIDGE.
Case of disintegration due to improper mixing, at Binghamton, N. Y.

To begin at the beginning, the reader is invited to obtain at his own expense about forty common soda crackers and a good sized needle and thread. He will note that each cracker is pierced with sixteen holes, and with the assistance of his nearest female relative he is requested to stack the crackers evenly as they originally came packed and to thread them together tightly by passing four threads through four holes nearest any one edge of the cracker, and knotting them snugly at each end of the stack. Next he is to place two inverted tumblers upon a table and rest his stack of crackers horizontally one end on each tumbler, so that the four threads are on the down side.

Following this recipe closely will give him a simple working model of a concrete beam—a soda cracker beam which will hold itself up and span the distance between the tumblers. A slight pressure of the hand will cause the crackers to squeeze together on their upper edge and at the same time cause a strain on the four threads near their lower edge; and this is exactly the condition in any simple beam. The crackers correspond

ANOTHER VIEW OF CONCRETE BRIDGE AT BINGHAMTON, N. Y.

to the concrete and the threads to the steel bars. If the downward pressure on the beam increases it will finally break in one of four ways. The crackers may crush at their upper edge; or the threads may break or the knots at the ends may pull through the holes and slack them up; or the crackers may slide past each other, the end ones up and the middle ones down—thus shearing the threads or tearing them through the holes. All these phenomena are exactly paralleled in a failing concrete beam. The concrete may crush or the bars may break, or pull out, or the whole thing may be sheared to pieces; and the game of designing concrete structures is a matter of adjusting two different materials in such shapes and proportion so as to waste no crackers and no thread but to have the combination equally strong at all points. But, since the relative prices of steel and of concrete materials vary in different localities, there can never be any standard design, but each structure is a new problem in itself. Add to this the fact that the designer is not dealing in rigid substances but elastic ones. According as our crackers are brittle or soft, and our threads stretchy or not, the ratio is going to be altered and our points of greatest strain are going to shift about. Moreover, while the steel bars have a certain stretch for each increase of pressure, the concrete has another stretch or squeeze ten or fifteen times greater. Worse still, while the stretch of the steel is uniform the squeeze of the concrete becomes greater and greater in proportion to its load as a falling body goes faster and faster every second. Here is a most delicate matter for bald heads and spectacles and differential calculus. But nobody engaged in the actual design of a concrete building could ever stop to go through all its details. All he can hope to find time to do is to go by certain rough and ready approximations which seem to answer the purpose well enough in most instances; yet the latitude which concrete designers allow themselves may easily be shown by quoting from a very interesting talk by Mr. Earnest McCullough. After stating how very indefinite and uncertain most specifications for reinforced concrete are, and describing how it is often necessary to work

CEMENT TILE RUINED BY SLOUGH WATER AND FROST.

twenty hours a day for three days on a set of plans before submitting a detailed design, he assumes that five different men with five different theories, and degrees of honesty set to work to design a concrete floor. The first man—a very honest one—obtains a floor seven inches thick. His steel carries a strain of 16,000 pounds per square inch and his concrete sustains a pressure of 700. The second man gets a five-and-a-half inch floor, but his steel and concrete stresses rise to 20,000 pounds and 940 pounds respectively. The third man, not so venturesome arrives at the same thickness of floor with 17,000 and 890 pounds respectively, for steel and concrete. The fourth man—presumably an honest boy just out of college—designs a six inch floor with stress of only 8,350 and 278 pounds, but he hasn't a snowball chance of getting the job for the other less conscientious men have beaten him on price. The fifth man having but one object in view—to get the job and the money (the devil take the consequences) designs a four-and-a-half inch floor, runs his stresses up to 19,050 for steel and 1,195 for concrete, and under the loose jointed, indefinite rules of the game, he is the victor and claims the spoils. From these figures it is easy to see that by its very newness and lack of all standards, by its danger from human cupidity, and by its combination of two totally different and varying elements, reinforced concrete furnishes difficulties even in its design never before presented by any structural material since men first began piling one stone on another.

Suppose, however, that a safe and economical design has been arrived at, how are we to specify that it shall be carried out? Most concrete is composed of three separate things,—cement, sand, and broken stone or gravel, and in order to be sound and strong the sand must just fill the spaces between the stones, and the cement must just fill the spaces between the particles of sand—as, for instance, we might fill a bucket full of oranges, then pour marbles in between the oranges and shot in between the marbles till no voids remained. But, since no two rock crushers run the same and no two cartloads of sand are the same, this is a matter which cannot be proportioned beforehand but must be done on the spot with no more delicate instrument of measurement than a string of rapidly passing wheelbarrows gauged by the eye. Mr. F. H. Meyer, a well known architect of the West said to me, "I do all I can to experiment before hand with my materials and to specify exactly, but when we start concreting a building I go down myself and stand by the mixer until I get the stuff just right." No other material that he uses would exact the same personal attention. Next we come to the cement. It is easy to specify what cement shall be, but while a steel bar or a brick or a stick of timber may be tested in an hour—almost at a glance—cement requires twenty-eight days to test after it has reached its destination. Think of the strong temptation on the one hand to make substitution, and on the other hand, the watchfulness to prevent any manner of underhand dealing in all that time! And the best cement can be "killed" by a little organic matter in the sand. Lastly comes the water. But

CONCRETE PIPE THAT COULDN'T STAND USE.

since the other materials cannot be measured exactly, neither can this. It is a matter of skillful guesswork and five per cent. too little may prevent the mixture from flowing into all the angles and crevices, while five per cent. too much may cause the cement to wash away leaving barren sand and rock behind it. And having mixed it properly then comes the problem of keeping it mixed. Every moment it stands in the wheelbarrows or in the forms the stones are settling to the bottom and the "soup" is coming to the top, and every moment after water touches it, that strange, unaccountable, indefinable, chemical action is going rapidly on and we must keep ahead of it. Even after we have placed it in the forms it is not safe. A bit of running water, a slight shift or a leak in the wooden frames, a hot sun or a touch of frost—even the smoke from a chimney or a drain from a stable—and our efforts are all for nothing, our money wasted, our good reputations gone.

In the face of these many difficulties it seems a bit unreasonable of my friend who gave his contract to the lowest bidder who in turn hired the most unskilled labor and the poorest paid foreman, to disparage concrete because his cellar leaked. It seems a bit lacking in the choice of words when Mr. T. W. Brown—a cement engineer—says "It is perfectly safe to say that in the ordinary use of cement concrete the work is so *carelessly* done that there is always danger of the work being seriously injured by infiltrations of alkali solutions." It seems a bit hasty of Dr. W. Michallis, Jr.—a cement expert—to say that "All Portland cement is doomed in time in sea water," but much more natural to observe with the editor of "Engineering News" that "the behavior of concrete in sea water is hardly uniform and not a matter of exact explanation."

It is, in fact, no time for us to contract a candy-girl nausea for a new thing only just tasted and not yet thoroughly understood. For every time we make a mistake we learn. There are at least a dozen cities I know of which will not

CONCRETE SHOWS WEAR OF WEATHER.
Chipped and cracked block that has no special strain upon it.

ALKALI WATER CAUSED THIS.
Disintegration in irrigation tunnel in Wyoming.

again attempt to carry sewer acids in concrete pipes. There is at least one influential firm who, another time, would expend the same care and gray matter in the building of a concrete factory as in making a camera to go in your pocket, and fare better. The other day I saw a concrete water tank twenty-two feet deep, three inches thick, cheaper than a wooden one, and not a drop of a leak from it—which shows what you can do when you know how.

When the guessers had all got through guessing why the floor surfaces disintegrated in the building surrounded by canvas and heated by charcoal fires it remained for Mr. Alfred H. White of the University of Michigan to discover an old forgotten equation about three inches long in a twenty-year-old chemistry which, with his own investigations, conclusively proved that at low temperatures, charcoal fumes could play havoc with new concrete. Next time that contractor erects a building in frosty weather he will ventilate it better. Similarly the wreck of the filtration plant at Lawrence finally desclosed the fact that ammonia from manure will soak into green concrete and ruin it. Next time that man will know better and use some other method of frost proofing his work, or wait until spring.

Similarly Mr. Jewett, the engineer in charge of the reclamation work where the drains have disintegrated, discovers by microscopic examination a myriad of fine crystals—the result of chemical action between the alkali in the water and the cement in the concrete —whose expansive crystallizing force would disrupt the toughest granite. Instead of investigating the people who placed this work he has investigated the composition of the work itself and added a definite discovery toward its further prevention.

In the same manner the curious and disastrous action of sea water on concrete is now coming to be better understood. A very clear statement of the case is made by Mr. John Taylor, the presiding engineer on a large quay wall placed almost entirely by divers in the harbor of Portland, England. The wall was built in horizontal layers about four feet thick by lowering concrete in closed buckets and dumping it carefully in place. On the completion of each layer and before the beginning of the next, it was found necessary to scrape away about three inches of concrete on top because the magnesium in the sea water had chemically combined with the

aluminum of the cement and ruined it. Would every builder take the pains to do that in forty feet of water? In the millions of dollars worth of concrete work that any principal sea port town has to construct, how often has it been done? But these and similar definite discoveries have not been without result; for now come the Krupp people of Germany with a new kind of cement containing iron ore instead of clay—or aluminum silicate — which the most rigorous trials and experiments seem to indicate will not be acted on by the sea water or alkali water either.

So far so good. It is apparent from even so superficial a glance as this over the failures in concrete that many millions have been spent in concrete work which was supposedly permanent but which a few years will prove is not. What with all our great piers, all our long pipe lines, all our sewers, all our shamefully unprotected concrete buildings, the total disappointment, if it could be expressed in dollars, would be a sorry sum to contemplate, comparable only to an earthquake or a plague or a small war. Yet for an engineer to talk against the use of concrete were as idle as for a minister to preach against golf; for the game goes on just the same and the mistakes of yesterday are discovered today and corrected tomorrow. Furthermore, with the gradual disappearance of timber and iron from the earth's surface we have got to use it whether we choose or not. But, to come back to the main point, since we must use it, let's bear forcibly in mind that there's nothing magic or alchemic about it, that it has no presiding goddess in aerial drapery to make it proof against all physical disadvantages; and that, unless used with the highest intelligence and most painstaking care it is neither frost-proof, nor fire-proof, neither smoke-proof nor filth-proof, neither salt water nor fresh water-proof, neither acid nor alkali-proof and most important of all, neither fool-proof nor knave-proof; and that when Thomas A. Edison endeavors to house humanity in indestructible everlasting concrete dwellings, far from merely reverting to the mud hut, he is undertaking a problem worthy of all the wonderful gray matter he possesses.

EFFECT OF FIRE AND WATER.
Concrete wall that crumbled like plaster when water struck its heated surface.

PLOWING FOR WHEAT ON A TWELVE-THOUSAND ACRE FARM, IN THOMAS COUNTY, KANSAS
In spite of up-to-date methods, the yield last year was but thirteen bushels to the acre. Everything is taken from the soil, and nothing put back, not even the straw.

REFILLING THE BREADBASKET

By

HARRY F. KOHR

MOST of our prophets of the latter day are attuned to the doleful key, and so, when there rises one who speaks with cheerful voice lets give him hail. His habitat is Kansas and his name is Ten Eyck. No tearful voice for him, no heark-from-the-tomb-a-doleful-sound when he speaks. He is the prophet of plenty.

"In twenty years," said James J. Hill, who is one of our most voluminous and, quite often, most pessimistic prophets, with tears in his voice, "in twenty years, at the present rate of wheat production, the world will go supperless to bed."

But not while Ten Eyck is on the job. "Here," he says, "is a wheat which will fill the world's breadbasket to overflowing and send it to bed with a stomach lined with three square meals and a Dutch lunch after the show. That," he said, as he held forth a handful of golden grains, "will produce sixty bushels to the acre. It has produced sixty-five and there isn't any reason why it shouldn't keep on producing sixty-five."

Wheat is the hobby of Prof. A. M. Ten Eyck, professor of agronomy at the Kansas State Agricultural College at Manhattan. He knows every variety of the grain by its first name and several of them he has named himself. What James J. Hill prophesied in his most sepulchral voice he knew seven years ago. Thereupon he turned his talents to the soil to breed a wheat that would send the world to bed with a full stomach. That was simple and there were two ways of doing it. One was to teach the farmer how to farm by giving

PROF. A. M. TEN EYCK.
Who has produced a wheat which "will fill the world's breadbasket."

back to the soil that which he took from it. The other was to give him better seed. He is helping the farmer to solve both these problems, but his greater efforts have been directed toward seed improvement.

As Mr. Hill saw it, we are at the limit, or nearly so, of our available wheat producing land. The average yield of wheat to the acre is slowly decreasing and the quality deteriorating. Each year our average acre produces less—either because it is unintelligently cultivated by wasteful methods; because its capacity for production is wearing out; or because the seed has degenerated. In the main, present conditions are due to a combination of all the causes.

Kansas, the greatest wheat producing state in the Union, produced last year eighty million bushels. That is a vast enough yield in the aggregate but an average of only thirteen bushels to the acre. A few years ago it was twenty. Other wheat states tell a similar story. Inevitably, at this rate, in a few years the demand will be so great, and the margin between yield and cost of production so small that prices would put bread among the luxuries.

It wasn't quite so bad seven years ago when Professor Ten Eyck sized up the wheat situation, but it was bad enough in his view to call for action.

Scientists tell us that if they could but select individuals and mate them and destroy the unfit offspring ultimately, they would be able to breed a perfect race of giants. That is how, seven years ago, Professor Ten Eyck began to replenish the world's bread basket—by rearing a breed of giant wheat, ruthlessly destroying as he went along the weak and unfit among the grains. By mating giant with giant, perfection in one quality with perfection in another, he has evolved finally a wheat which will produce sixty-five bushels to the acre!

That result multiplies by exactly five the average production in Kansas. But it mustn't be assumed that by planting such seed the crop production of Kansas is to be quintupled in a single season. Professor Ten Eyck is a practical man. He dreams no such dreams. He merely says:

"In five years we expect to double the wheat yield of the state. The planting of thoroughbred seed alone will increase it twenty-five to fifty per cent. Pure bred seed, fertilized soil and scientific tillage of the seed-bed will increase it from one hundred to one hundred and fifty per cent. When the yield in Kansas is increased one hundred and fifty per cent the acre average will rise from thirteen to thirty-two bushels and it could be double that.

HEAD ROWS OF CRIMEAN WHEAT.
The row from which was developed the Ghirka wheat which yields sixty-five bushels to the acre.

TEN-ACRE TESTING PLOTS OF WHEAT AT THE KANSAS STATE AGRICULTURAL COLLEGE.
Different varieties can be distinguished in the light and dark tints in the photograph.

The wheats best suited to the Kansas soil are the hard winter varieties from the Russian Crimea. Turkey Red is most extensively grown. It is a good drought resister and fitted for a rigorous climate. But taken from its natural habitat and planted in the effete soil of Kansas, damper and warmer than its native soil, it degenerates, softens. Hard wheat makes the best flour and the Kansas product is in great demand. But when the wheat begins to soften the miller steps in and demands that the farmer maintain the quality of his product and go back to the steppes for more seed. But that is costly, and the farmer who gets only thirteen bushels to the acre cannot afford often to do that.

That is where the farmer begins to realize on his investment in the agricultural college. "Hold," cries Professor Ten Eyck, "I will supply you better seed than Russia ever grew."

Of all the hundreds of varieties of wheat to be had, Professor Ten Eyck found about a dozen that gave promise of development into big producers. Included in the dozen were several Russian varieties. From this dozen he selected 1,340 heads and applied the "head-row" tests. This is simply the planting of all the kernels from one head in one row and so on. He played no favorites. All the rows were given the same soil and attention. It was a race for the survival of the fittest and each little grain of wheat must hustle for itself. When the grain ripened, Professor Ten Eyck would go mercilessly through it and cull out the unfit heads and throw them away. In one experimental crop the best row yielded 349 per cent more than the poorest and forty-six per cent more than the average of all the other rows. The best heads were carefully sorted and planted again in head rows. Season after season this process was carried out until finally two big producing strains definitely were

established, each of them apparently able to maintain indefinitely the much desired qualities of hardness and drought resistance. One was called Ghirka, and from it one farmer raised a crop of sixty-five bushels to the acre. The other variety was called Kharkof, and at the Agricultural College it produced sixty bushels to the acre.

THRESHING OUT SIXTY-FIVE BUSHELS TO THE ACRE.
Scene on the Hamm farm, near Holton, Kansas.

Of the two new wheats, the Kharkof seemed to Professor Ten Eyck to be the superior in all desired qualities and preparations were at once made to produce Kharkof for seed. This year more than one million bushels of that wheat will be raised in Kansas, counting on an average of only thirty bushels to the acre. Next year, all conditions being average, Kansas ought to eclipse its greatest wheat crop records by millions of bushels and have grain enough in another year to seed the entire country with the new wheat.

"It is not folly to predict," Professor Ten Eyck said, "that the resulting increase in the yield of wheat from the planting of that improved seed will astonish the world. From it we have grown sixty bushels to the acre, here on the agricultural college farm, and anybody else can do the same thing."

"But," some will say, "it is easy enough to raise big crops on a state experiment farm where every condition is exactly right and the farmers scientific experts." Professor Ten Eyck is ready for that.

"The conditions on that farm," he said, "are not better than on the average well tilled farm in Kansas. It is only ordinary soil, all 'wash land'—that is, on hillsides that wash with every rain. We use only common farming methods, otherwise our experiments would not be so valuable. Any farmer who takes proper care of his land can get just the same results that we

WHERE PROFESSOR TEN EYCK DEVELOPED HIS SIXTY-FIVE BUSHEL TO THE ACRE WHEAT.
Grain breeding plots at the Kansas State Agricultural College.

get here. And then, there was W. G. Hamm of Holton, Kansas, who bought seed from the college and raised sixty-five bushels to the acre."

Mr. Hamm, be it known, is a preacher as well as a farmer. He might have sermonized forever to his little Sunday flock and his name would never have been uttered abroad, but when he sowed and reaped a crop of wheat that had more bushels to the acre than any man in Kansas had ever raised before, he preached a sermon that has thundered through the length and breadth of Kansas. His text was the parable of the sower and the seed and his pulpit the eternal hillsides of Kansas.

There are two classes of farmers. One never learns anything and the other is always learning something. Mr. Hamm is one of the latter class. He makes a business of farming. Forty-seven years ago his father took up a claim near Holton. For forty-two years one field was planted season after season in corn. Then the son took hold of the farm. Year after year its crops had averaged less to the acre. His preaching hadn't interfered with a study of modern farming methods and he combined his practical experience and his book learning to show the "old man" a few things about cultivating the soil. He took that "corned-to-death" cornfield and nursed it like a spoiled child. He disked it and harrowed it, he scattered manure over it and he repeated the process after every rain. That was in 1908.

When seeding time same Mr. Hamm sent to the Kansas State Agricultural College for seed and was supplied with enough of the Ghirka wheat to plant his field. The wheat was sowed about October 1 with about one bushel of seed to the acre. Cattle were grazed on it in the fall and winter and in the spring it was manured again. Cutting began in July and when the threshing was ended in September it had yielded exactly sixty-five bushels to the acre, machine measure. That wheat Mr. Hamm has sold to other farmers for seed at $2 a bushel. Where the average Kansas farmer realized $13 an acre from his wheat Mr. Hamm realized $130.

And so, if Mr. Hill's calamitous prophecy ever comes true it will not be because Professor Ten Eyck has not done his part in providing the means wherewith conditions may be remedied nor Mr. Hamm the demonstration of how the remedy may be applied.

WORLD'S GREATEST SEAPORT

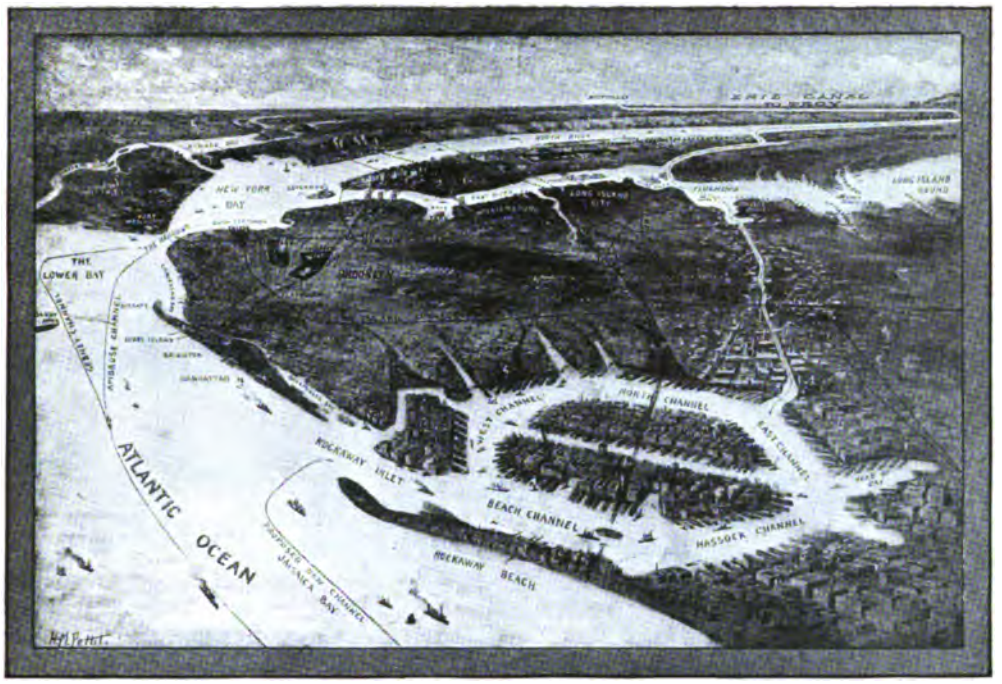
By

CHARLES FREDERICK CARTER

SO they're going to give the port of New York room to grow!

It's all settled. Congress, the legislature, the city council, the Board of Estimate and Apportionment, and Mayor Gaynor, have all agreed upon the plans for the Jamaica Bay improvement; most of the red tape has been unwound, the first instalment of a series of appropriations that may ultimately aggregate seventy millions, more or less, has actually been made, and in a very short time the dirt will begin to fly; or, to put it literally, the mud will begin to flow.

When it is all over the metropolis of the Western hemisphere will be the world's greatest seaport, with the most extensive harbor, the most liberal allowance of docks and wharves and the most up to date facilities for the economical handling of freight to be found anywhere. Incidentally these things will help materially to make the city, the major part of which by that time will have moved over to Long Island for lack of any other place in which to spread out, the metropolis of the world; for by 1950, or sooner, it is expected to have at least ten million inhabitants. Some of



A BIRD'S EYE VIEW OF JAMAICA BAY AS THE IMPORT AND EXPORT TIDEWATER OF THE ERIE CANAL.

the more enthusiastic prophets make it twenty millions.

Before the significance of the Jamaica Bay Improvement can be properly appreciated it is necessary to review the geography of New York and the commercial conditions arising therefrom.

Of course, New York is something of a seaport now. About thirty-eight per cent. of the nation's foreign trade and nine-tenths of all trans-atlantic passengers pass through the city. Indeed, New York today leads the world as a commercial city. The 4,183 vessels, aggregating 12,481,861 net tons, entering from foreign ports in 1908, and the 4,061 vessels, aggregating 12,327,372 net tons, clearing for foreign ports, made a grand total of 24,809,233 tons. The value of imports at New York for the calendar year, 1908, was $641,552,984; and the value of domestic exports was $614,-489,283. In addition it is estimated that commerce valued at $24,000,000 annually passes through New York in transit to other countries without being landed. Three-fourths of all the sugar and coffee imported into the United States, nearly half the tea, more than three-fourths of all the cotton, silk and wool manufactures, ninety-six per cent of the rubber, eighty per cent of the tin and sixty per cent of the hides and skins imported enter the port of New York. This takes no account of the coastwise traffic, which ten years ago was more than double the amount of foreign trade. But occasionally a few carloads of wheat get away and are shipped to Liverpool by way of Montreal. Whereat the newspapers abuse the trunk lines, and the Chamber of Commerce sends a delegation hot foot to Washington to complain to the Interstate Commerce Commission about it.

Until very recently Nature has been given great credit for cleverness and liberality in providing New York with an inland harbor that has been classed among the world's best. No doubt Nature deserves the highest commendation for good intentions, but if the honest truth must be told she rather made a mess of it in designing New York harbor; for it is not nearly large enough to handle economically the traffic that offers today. And even under present adverse

THE ENTRANCE TO JAMAICA BAY.
From the extreme point of Rockaway Beach looking west.

conditions a steady increase in the tonnage of vessels entered and cleared is imposed upon the already overcrowded waters. The increase from 1905 to 1908 was 5,152,364 tons. In twenty years the increase in tonnage has been 121 per cent.

It certainly sounds imposing to say that the water front of New York harbor, including the thirty miles of Jersey shore from Amboy to Fort Lee, foots up a grand total of 478 miles, which is eight miles more than the entire coast line of the independent maritime nation of Holland. But while this great expanse of

ONE OF THE WINDING CHANNELS OF THE VICINITY.

water front makes a brave showing on the map it isn't nearly so big when the unavailable parts are eliminated. The distance from the foot of West Seventy-second street to the northern limits of the city is of no commercial value because it is backed by a high hill and a public park. The Harlem River adds some miles to the water front but it is almost entirely useless because it is a narrow channel spanned by so many drawbridges going vessels. The only available room for increase would not provide for more than 250,000 additional feet of wharfage.

To still further embarrass commerce, the harbor has been turned into a cesspool which is filling up at a rate which suggests the impending necessity of fitting vessels with casters if they are to continue to navigate it. As if all this was not enough, the railroads needed the harbor for yards; and when a railroad

A SUMMER COLONY IN JAMAICA BAY.
The Long Island shore shows dimly in the distance.

that a tug is often an entire day making a trip in with a tow and out again. While Bronx Borough has a water front of nearly a hundred miles the only part of practical value is a short stretch between Cabot street and Hunt's Point. From One Hundred and Thirty-second street to Oak Point on the East River the channel is narrow and close inshore thus making the construction of piers impracticable. Finally, the shore line of Staten Island, or Richmond Borough, adds a great deal to the total, yet is almost worthless from a practical standpoint because of its inaccessible location.

Upon getting right down to facts, therefore, New York harbor turns out to be not so very big after all. The present available wharfage aggregates about one million linear feet, of which only about ten per cent is allotted to ocean needs a thing it just helps itself. Seventy-five per cent of all freight received at, or forwarded from, New York is handled on car floats and lighters which crowd the waters so thickly that only the most acrobatic of pilots can wriggle through with a steamship. The railroads are not to blame. Ships must be unloaded and loaded. To lay tracks for this purpose upon the skimpy little island of Manhattan, where there is scarcely room for the headlines in the evening papers, to say nothing of less obtrusive objects, is not to be thought of. On the Jersey shore the hills come down so near the water's edge that there is no room for adequate terminals. Thus there was no alternative but for the railroads to become amphibious. The wonderful success with which this unique situation has been met would make a fascinating

THE LARGEST SETTLEMENT IN JAMAICA BAY.
All the houses are built on piles, as occasional storms drive the waves clear across the island.

story were there space to here present the facts.

Such being the conditions it is not surprising to find that a memorial signed by a large number of prominent business men was presented to Mayor Gaynor a month after he had taken up his office, reminding him that a large amount of commerce was being diverted to competing ports by extortionate charges and inadequate dockage facilities and urging him to use the influence of his position to improve conditions. More than ten years ago Mayor Van Wyck was similarly petitioned to save the coasting trade that was being driven from New York by lack of wharf room at rates the traffic would bear.

While New York was thus asleep at the switch Newark, an inland town in New Jersey, laid plans to dig her way through the salt marshes to deep water and thus capture the cream of the neglected commerce. The Newark scheme provides for a shipping, manufacturing and transportation zone just south of Passaic light, on the western shore of Newark Bay four thousand feet wide and twelve thousand feet long, containing a central channel seven hundred feet wide in the clear, reinforced by a number of large piers and slips capable of accommodating large ocean going steamships, and by a basin six hundred feet wide by two thousand feet long on which there are to be several public renting places at the end nearest Newark. The depth everywhere is to be thirty feet to begin with. Nine hundred acres to be reclaimed from the salt marshes with the dredging spoils will be available for warehouse and factory sites. The Jerseymen figure that as a very large proportion of the freight handled by the railroads consists of import and export traffic they can save millions of dollars by their up to date terminal where cars can be placed alongside vessels, thus eliminating expensive lighterage. The advantages are so obvious that they expect by 1950 to be doing a business amounting in weight to 3,750,000 tons and in value to $174,000,000 annually.

When the Newark enterprise was launched New York began to take notice. Obviously the only directions in which there is room for the indefinite expansion of the city's commerce is southeast and east along the two hundred and eighty miles of Long Island's coast line Even this was not economically possible until the recent completion of numerous bridges and tunnels transformed Long Island into an annex to Manhattan.

A commission was appointed to examine and report upon the most available spot for the first and most important extension of harbor facilities, which is Jamaica Bay. This undeveloped harbor lies within the limits of Greater New York, the entrance to the channel being only eleven miles from New York City Hall. As the entrance channel lies east of, and six and five-eighths miles distant from Sandy Hook, trans-Atlantic liners could save about six hours time by turning into the new harbor instead of following the slow and tortuous course across the outer bar, through the lower bay, the narrows and the crowded upper bay to an inconvenient pier in Hoboken. Moreover, the entrance to Jamaica Bay lies outside the fog belt which so frequently compels vessels to wait for a chance to get in. So far as the personal convenience of passengers is concerned Jamaica Bay will be a great improvement upon Hoboken; for electric express trains running under the East River will transfer them in eighteen minutes to the very heart of the city, within a few blocks of the big hotels, or to a station from which they can take a train for any part of the continent without setting foot out of doors.

At present there is not much to suggest a great world harbor at Jamaica Bay. The bay itself is a shallow sheet of water covering an area of 16,170 acres, or 25½ square miles, in which a few oysters are grown and a few unsophisticated minnows are caught by holiday fishermen. Adjacent are 8,500 acres of salt marsh, the present home of untold billions of mosquitoes. There are 4,200 additional acres of marsh land apart from the main body, making the total area of bay and marshes 28,970 acres, or 45½ square miles, which is double the area of Manhattan Island. All that breaks the monotony of this dreary expanse at present is the aroma from the garbage reduction works on Barren Island at the western end of the bay.

The plans drawn up by the Improvement Commission, when fully developed, will provide a channel 43,000 feet long, measured along the westerly and northern pierhead line, giving access to 80 piers on the mainland each with a width of 125 feet, separated by slips 300 feet wide. If the piers are built at an angle of 45 degrees with the bulkhead line each may be a thousand feet long, thus affording 160,000 linear feet of wharfage, or about one and two-thirds times the amount of wharfage now available for ocean going vessels. Improvement of the marshy islands in the bay, aggregating 4,200 acres, would more than double this amount of wharfage. The National Government is to dredge an entrance channel, the outer end of which will be protected by Rockaway Beach, a natural breakwater.

According to present plans the en-

ONE OF THE BROAD BUT SHALLOW CREEKS THAT EMPTY INTO THE BAY.
It is proposed to dredge these out, widen and deepen them, and convert them into navigable channels, lined with docks.

trance channel at first is to be 500 feet wide, but is to have a depth of only 18 feet, which would shut out ocean going vessels. At some future time it is to be enlarged to a width of 1,500 feet and a depth of 30 feet. The idea of the majority of the Improvement Commission is that the only purpose to be served by creating the new harbor at the outset will be to promote the growth of the territory tributory to Jamaica Bay by providing for the delivery of building material at a low freight charge. This territory in 1907 consumed 1,600,000 tons of building material and 400,000 tons of fuel, which, the majority thinks, would justify the construction of an 18 foot channel and harbor. The Newark Commission, being composed of men with livelier imaginations, foresaw the wisdom of providing for ocean going carriers by creating a depth of 30 feet at the outset. With this sort of competition so near at hand it is not difficult to foresee an early change in the Jamaica Bay plans.

At the head of the basin a public wharf 1,150 feet long and 100 feet wide is to be provided. Parallel to the basin on both sides about 400 feet back from the bulkhead are to be streets 120 feet wide which will give the railroads access to the wharves and factory sites by suitable spurs. The wharves are to be provided with electric cranes, telpherage systems and other modern devices for the prompt and economical handling of the freight.

The new harbor is to be the tidewater terminus of the thousand ton barge canal now being built by the State at a cost of $101,000,000 from Lake Erie to the Hudson River which is expected to bring ten million tons of freight to New York annually. Plans are already afoot to provide a short cut for the barges from the Hudson by way of the Harlem River to Flushing Bay and thence by a canal eight miles long across the western end of Long Island to Jamaica Bay, thus avoiding the congested waters of New York harbor and incidentally avoiding also possible rough water in the lower bay. Barges loaded directly from lake steamers can be brought alongside ocean liners where their cargoes can be transferred at a minimum expense.

Barring a thin layer of mud the material to be dredged is clean sand which is to be used in filling up the marshes back of the bulkheads by the method by which Galveston was so successfully built up above the danger of future inundations. Such material is easily handled by modern dredges which are capable of delivering the material at great distances with wonderful rapidity. A suction dredge at Oakland, Cal., delivered material through a twenty-inch pipe a distance of 6,170 feet. Another at Baltimore pumped material ashore through a

BROAD CHANNEL, PRACTICALLY THE ONLY CHANNEL NAVIGABLE AT PRESENT, FOR LARGE VESSELS, IN THE BAY.

THE SALT MARSHES AT JAMAICA BAY AT LOW TIDE.

pipe line 10,797 feet, or a little more than two miles long. Part of this line, though, was down hill. The pressure at the pump was only 28 pounds per square inch. While the recognized effective size of suction dredge for delivering material ashore is one using 30 inch pipe, at least one has been built with pipe 42 inches in diameter. The percentage of solid matter that can be carried in a dredge pipe line varies greatly according to the material. Some clays can be pumped with only 10 per cent of water, or just enough to lubricate them. The carrying capacity of a 36 inch pipe discharging material composed of 80 per cent solid matter at ten feet per second is 7,400 cubic yards per hour. Few suction dredges are so effective as this, though, because much of their power is generally wasted pumping water carrying a small percentage of solid matter at a needlessly high velocity. But the operation is so simple and effective that it more than offsets this waste of power. The famous suction dredge J. Israel Tarte, belonging to the Canadian government, has demonstrated its ability to deepen a channel in blue clay, which is very much harder to handle than sand, four feet for a width of 325 feet a distance of a mile and a half in a month. In 26 days in September, 1903, the Tarte dredged 757,100 cubic yards of blue clay from a depth of 35 feet and delivered it 2,000 feet away.

The great dipper dredge Onondaga, used in New York harbor, has a dipper with a capacity of fifteen cubic yards and is capable of working at a depth of 50 feet. A dredge of this type, but with a dipper of only four cubic yards capacity, in use in Lake Superior, has a record of 5,900 cubic yards in sixteen hours, and 111,000 cubic yards in a month.

From this it may seem that the task of moving a couple of hundred million cubic yards, more or less, of sand from where it is not wanted to where it is wanted in order to create an artificial harbor in Jamaica Bay is a simple one from an engineering standpoint. Maintaining the depth may be more difficult, for it may involve some nice calculations to proportion the interior basin to the entrance channel so that the tidal scour will keep the channel clear. The government engineers are of the opinion that it will also involve the building of jetties and more or less constant dredging at an estimated cost of $55,000 a year. The total cost to the Government of the plans recommended, including the expense of widening and deepening the entrance channel and building jetties is estimated at $7,430,000. The total cost of the entire improvement ranges all the way from $13,565,000 as estimated in the majority report to $47,089,000 in the minority report and $69,270,000 according to the ideas of the chief engineer of the board of estimate and apportionment. Others swell this to a hundred millions.

But that the game will be worth the candle all are agreed. The filled in lands, which may aggregate as much as fifteen thousand acres, will be worth fifteen millions dollars to the city which will own them. Indirectly their value will be beyond computation; for they will afford factory sites that will make New York the world's greatest manufacturing center.

In fact New York is today the greatest manufacturing center in the United States. The Census Bureau's special report on manufactures for 1905 gives the value of its manufactures as $1,526,523,000, an increase over 1900 of $353,652,745. In the five year period the manufactures of Queens Borough increased 162.3 per cent, a showing not approached by any other locality in the United States. The value of the Borough's manufactures in 1905 was $92,941,158. If to this be added Brooklyn's $373,462,930 worth of manufactured products the possibilities of the two boroughs most directly affected by the Jamaica Bay improvement may be appreciated.

With ocean going vessels bringing to their very doors wool from Australia, hides from Argentine, cabinet woods from Brazil, cotton, yellow pine and hardwoods from the South and other raw materials culled from the fields, mines and forests of the whole world at the lowest possible charge for freight, with the least possible delay and with a minimum for handling; with cheap fuel brought in barges from Newport News and with an inexhaustible supply of labor always at hand the factories of New York will be most fortunately situated.

It has been the invariable experience of cities that the increase of business keeps pace with the facilities provided therefor. Antwerp spent millions for wharves and modern facilities for handling freight and thus increased her commerce 200 per cent. in twenty years.

HOW YOUR FISHING ROD IS MADE

By

HARRY H. DUNN

The making of fishing rods is coming to be a pleasant and remunerative employment for men and women who can do things with their hands and with small tools. The pay for rods of the first class ranges from $20 to $50, with higher prices for especially ornamented rods and several can be made at one and the same time, so that the output is limited only by the skill of the maker. Among the minor trades which can be self-learned, this is one of the most pleasing and one which is being brought into great demand by the recent rise in deep sea fishing along the lines of light tackle and fair play to the fish.

WITHIN the past three years, since the inception of the record-seeking clubs of Aransas Pass and Catalina Island, in Texas and in California, respectively, there has sprung up a new industry for men, and even women, who work with their hands, and who are clever at the crafts of the plane and the glue pot.

This new industry—trade it might almost be called—is the making of the rods with which the great three and four-hundred pound fish of Gulf and Pacific coast waters are taken by enthusiastic Waltonians, who scorn the methods of the handliner and of the heavy tackle enthusiast.

The rods on which these fish are caught—"taken," is the correct word, according to the anglers—have been reduced in weight until now there has been formed at Avalon, Catalina Island, on the California coast, a "Three-Six Club," which uses *six-ounce* rods and six-thread lines. On such tackle as this forty-pound fish have been caught after an hour's battle, while the enthusiasts hope to take even the lordly tuna on their knitting needle rods and cobweb lines.

NINE-OUNCE RODS IN USE.
Wharf fishermen on the Pacific Coast are enthusiastic for light tackle.

Nine-ounce rods, only an ounce more than half a pound in weight and six feet in length, are in common use up and down the West Coast, and no trophies are awarded by any of the fishermen's clubs for fish taken on tackle heavier than this, or with lines of greater strength than the nine-strand Cuttyhunk.

As may be imagined, these rods, which are all of wood or split bamboo, long and slender, tapering from barely more than half an inch in thickness at the seat of the real to three-sixteenths of an inch at the tip, have to have the strength of steel combined with an even greater bending power. I have seen, when fishing off Catalina, a nine-ounce rod bent double with the fighting strength of a thirty-pound albacore, enduring a strain which would have tried the best of steel rods, with the added drawback that salt water is deadly to steel rods.

The making, then, of these split bamboo or wood rods must be perfect in every detail. For instance, from butt to tip they are wrapped with the finest and toughest of silk thread. A single overlapping of two of these threads, a single twisting of the thread so that the fibers become separated, might at a crucial moment, so weaken the rod that a fighting fish would escape, and the rod might be broken, or, what is worse, bent so that it could never be straightened.

Wood, be it betharaba or the best lancewood, is going out of favor with most salt-water anglers who go after big fish. It is said to lack the resiliency of the bamboo and also to become bent at undue strains with greater ease than the rods which are made entirely of the split cane.

The making of one of these split bamboo rods, then, becomes nothing less than an art, and one which is of as great care as the making of a watch or the shaping of the hull of a racing yacht. For this reason, while sporting-goods houses are constantly offering rods of this material as low as five dollars each, the skilled angler scorns these products of machinery and buys direct from the maker, who, with the guaranteed labor of his own hands and tools, produces rods which when properly handled, no game fish has ever been able to break.

Of course, these rods cost more than the product of the machines of the wholesale makers, but they last a lifetime, their weight is practically nil, and the demand for them has become so great that the making of fishing rods is becoming a profitable means of livelihood for those who have the requisite skill and knowledge to produce the best.

The first step in the making of one of these rods, is, of course, the material. This comes in the form of straight pieces of bamboo about eight or ten feet long, usually from China or Japan, Tongquin being the greatest point of export. When this is received by the rodmaker, it is dry, but he puts it in a kiln especially constructed for the purpose, and dries it again, until it is what is known as "bone dry."

Then, in his shop, he splits this cane delicately and carefully so as in no way to injure the natural "enamel" of the exterior, into sections suitable for the size of the rod he is about to build. This splitting process is one of the most difficult of his entire task and the only tool with which it can be done successfully is a pocket knife with a razor edge. Every one of the pieces so split from the main "trunk" of the bamboo, must be of the same width. Then the inside of each, and the sides as well, are planed down until the bamboo, which is originally from an eighth to something less than a quarter of an inch in thickness, is, in cross section, an equilateral triangle, with the enamel still on the outside, and forming a perfect wedge.

Six of these with the rough places on the joints planed down, are put together, with the enamel side out, to form a hexagonal rod. Each one of the sections having been tapered before the rod is put together, the whole rod has the taper which it is destined to have when completed. Each section, also, before the six are put together, is treated to a coat of waterproof, non-cracking glue, made especially for this purpose. Then the entire rod, now beginning to take on embryo form, is wrapped tightly with strong cord, and put away in the drying room, where temperature of about 100 degrees is maintained, day and night. This drying, also, is a delicate process, and one which must be watched with the greatest care. Too much heat will make the rods too brittle, while, too low a temperature will tend to make them spongy and unresponsive at a time when all the "springiness" they possess is brought into requisition against some fighting finned game of the sea.

Inside the drying room, where the completed rods are hung, as will be told later on, there is a long box, standing high enough to contain the longest rods the maker will be called on to build. Into this the freshly glued, hexagonal rods are put and the heat from a lamp beneath turned on. This gives them the first heat from the source of all the warmth of the drying room and so keeps them somewhat warmer than the wound and varnished rods to which the finishing touches are being put in the outer part of the drier.

The length of time which the rods remain in this hot box varies with the diameter of the rod, the amount of glue applied and the porosity of the bamboo itself. Some bamboo, particularly that grown in the southern part of China, is more porous than other varieties, and it is impossible for the rodmaker to differentiate the two before the drying room temperature is reached. For this reason, in so far as is possible, the rodmaker must be a judge of bamboo, and as there are as many kinds of bamboo as there are of the eucalyptus, he becomes in a way a specialist in bamboo—if he takes up his work to carry it to the highest point of excellence.

When the rod comes from the drier, the string wrapping is removed, and with it the outside glue peels off, leaving the rod perfectly smooth on the outside, with the natural surface of the bamboo out. This is as smooth as glass, and the rod is then tested for its bending powers. If it does not show the proper resilience—that is, if it will not bend double along every one of its six faces—it is then thrown away and all the work which has been done on it goes for naught. Not alone in one direction must the rod answer every strain put upon it

with an ever-elastic bend and spring, but it must be equally resourceful in every direction from which strain can possibly come.

But if the rod passes these requirements, it is then ready to be wound. For this purpose a sort of lathe is used, long enough to contain the whole six-foot rod. Into this the rod is clamped, and, with spools of vari-colored silks at his elbow, the rodmaker begins the most tedious of all his tasks. The spools are on reels, geared to move with the rod. Power is applied to the winder by the right hand of the operator, while with his left he guides the thread which is overlaid on the entire rod from tip to butt.

Usually the general color of the thread used in winding the body of the rod is light, gray, white, green, or light blue being most common, while wherever there are joints in the bamboo, an extra layer of darker silk, an inch or so wide, is put on to strengthen the joints. After this winding is accomplished, the entire rod is varnished.

Then the "guides," small eyelets which are to carry the line along the rod to the tip, are put in and each wrapped with strong silk, and each new winding in turn varnished. The rod goes to the drier again for another period, in which it is thoroughly dried again and the whole comes out to be finally tested for resiliency. This is usually done by attaching a line of the requisite weight to the end and then testing it with weights of the size of the fish likely to be taken.

If it fails to answer any of the requirements put on it by these imaginary fish, it is destroyed. No thought is taken of the work necessary to produce such a rod by first class makers, and no attempt is made to market it, even as a second-class rod. There are, in fact, no such things as "second class fishing rods."

A PAINSTAKING TASK—WINDING THE ROD WITH SILK.

All are of the best or else they are not turned out.

With guides which are put on before the rod goes to the drier there is also a "tip" which covers the smaller end of the rod and provides the final eyelet through which the line is to run. On the better class of rods the holes in these guides and in the tip are made of agate rings. These serve a double purpose: They will not fray the line, and sand on the line, which cuts a steel eyelet like a knife cuts cheese, makes no impression on them.

After the rod came out of the drier for the first time, the rough places, which were joints in the original bamboo, are smoothed down with a small plane or with a rasp, and now that the whole rod is covered with silk, it is practically circular in cross section and begins to take on the beautiful symmetry of which they are the synonym.

This circular form is maintained down to the tip even in the tiny six-ounce rods of the Three-Six Club of Catalina, and the taper is perfect, running according to a scale which each rodmaker practically figures out for himself, so that there is an established figure for the diameter of the rod about every six or eight inches.

A steel or tin butt piece is then put on the rod so far completed, and what is known to anglers as the "tip" of the rod, which contains only this one joint, is completed. To prepare the butt of the rod the angler takes a piece of seasoned wood, preferably one of the selected varieties for the making of wooden rods, and from it turns a ribbed handle, which might be compared to the "grip" on a shotgun or rifle, and which is known technically to fishermen as the "butt" of the rod.

At the upper end of this a hole is drilled to receive the "tip" just finished, and into this is set a tin or steel lining, into which the metal tipped base of the "tip" will fit when the rod is put together. The upper end of this butt also is covered with a metal sheath or ferule, on which a place is made for the reel and a sliding ring to fasten the reel to the rod. This is known as the "reel seat," and is one of the most important parts of the rod, for on the reel and its free action depends much of the success or failure of battles with big fish.

Having turned his rod butt, the rodmaker wraps it with fine strips of rattan or of the outer layer of the bamboo. This gives it the corrugated appearance commonly seen on rod butts, and, in turn, must be dried and redried and carefully varnished after it has been glued to the wood base. This, with a metal cap over the bottom of the butt, practically completes the rod, which only has to have a canvas, chamois-lined case for the tip to be ready to go into the fight with a forty-pound yellowtail or a 250-pound tuna.

An Assortment of Rods and Reels.

Then comes the, to the rodmaker at least, most interesting part of his rod making — the selling of the finished product. A rod such as has just been described in the making is worth from twenty to fifty dollars when completed. One which *looks* just like it could be bought in the downtown store for from five to fifteen dollars, but when the fisherman hooks a fighting yellowtail of half a hundred pounds weight and begins to fight him in four hun-

WINDING THE ROD BUTT WITH THIN STRIPS OF RATTAN.

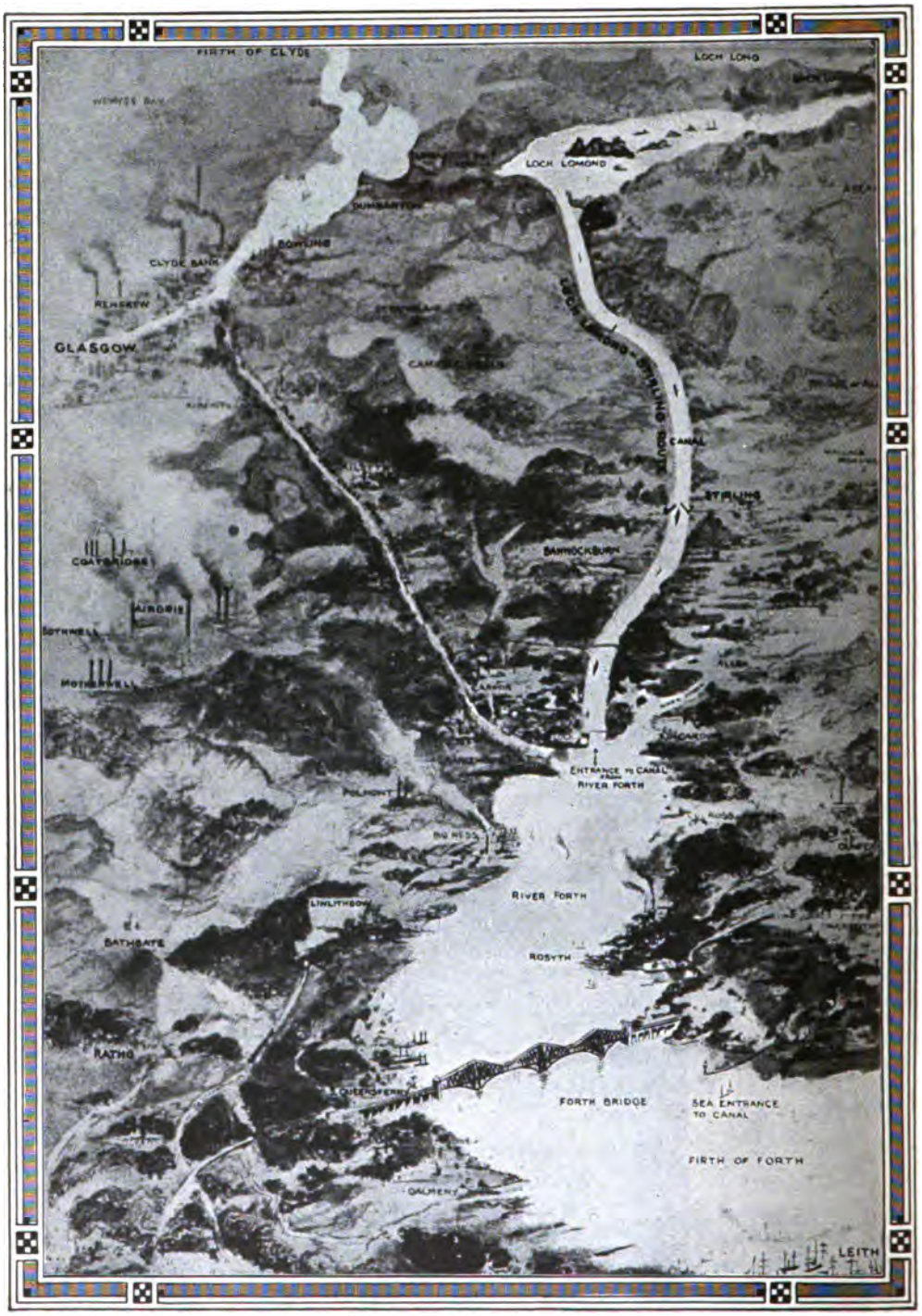
dred feet of clear sea, he soon discovers the difference between the real and the imitation.

From a week to a month, depending on the character of the materials used and the fine work to be put in on it, are required to complete such a rod. Occasionally the drying, on which so much depends, delays this to a longer time, but as a usual thing a fortnight is enough to make the best kind of a fishing rod known. All in all, the business is remunerative, for the good rodmaker can have three or four rods building at once just as well as one, and his skill with his fingers alone limits the amount and value of the product he may be able to put forth.

Dirge for a Soldier

Close his eyes; his work is done!
What to him is friend or foeman,
Rise of moon or set of sun,
Hand of man or kiss of woman?
Lay him low, lay him low;
In the clover or the snow!
What cares he? He cannot know;
Lay him low.

—G. H. BAKER.



BIRD'S EYE VIEW OF THE ROUTE OF THE SHIP CANAL. FROM THE FIRTH OF FORTH TO THE FIRTH OF CLYDE, THROUGH LOCH LOMOND.

TO CUT SCOTLAND IN TWO

By

CECIL BEMBRIDGE

BY the further advancement of a notable project for the construction of a huge canal through central Scotland, a new phase is opened in mercantile traffic which cannot fail to exercise some influence upon the marine trade between this country and Europe. The idea is by no means a new one, having been discussed and persistently advocated for about a quarter of a century, but it is only within the past few weeks that it has been brought within the range of possibility by the action of the British Government, who, recognizing the strategical value of such a short cut between the seas washing the western and eastern shores of Great Britain, have communicated their appreciation of the idea and have expressed their preparation to extend it a measure of financial support. The Admiralty suggest that it should be essentially a commercial canal capable of handling the largest vessels, but made 148 feet wide at the bottom, instead of one hundred feet as originally contemplated, so as to admit of the passage of the largest battleships of the British navy.

If you examine the map of Scotland you will see that the country narrows considerably between the large estuaries of the Forth on the eastern coast, and the Clyde on the western coast, respectively. As the crow flies the width of the neck of land is but a few miles, and although at first sight it may seem but an easy matter to carve a ditch through this narrow isthmus, it would however prove terribly expensive as it would entail the dredging of a deep channel in the upper reaches of the Clyde.

As a matter of fact the digging of a channel through this connecting neck of land occupied the attention of engineers early in the beginning of the last century. The upshot of their deliberations was the construction of a barge canal from the upper reaches of the Firths of the Forth and the Clyde, as these large indents in the Scottish coastline are called. The line of this canal, suited only to small craft traffic, followed practically the shortest route between the open water on either side.

DAVID ALAN STEVENSON.
Father of the projected canal across Scotland.

About twenty years ago the idea of widening this existing canal, so as to accommodate large ocean-going vessels, was seriously discussed and an influential financial syndicate approached Messrs. Stevenson and Company, the eminent engineers of Edinburgh. These engineers have had wide experience in regard to artificial waterways, and the adaptation of estuaries to such traffic. They thoroughly investigated the project in all its bearings, and finally reported that the existing barge canal could not be widened and deepened to meet the

new requirements, except at prohibitive cost, and then the results would not be amenable to the class of traffic it was desired to attract. In the course of their investigations however, the engineers ascertained a more practicable route for the canal, and its feasibility from all points of view so impressed them that they took up the question in grim earnest, and have hammered away incessantly at the project ever since. Mr. Alan Stevenson, B. Sc., A. M. I. C. E., has been especially active in the education of the public in the scheme, has delivered papers innumerable before technical, scientific, commercial, and public institutions, as well as appearing before the recent Royal Commission on Canals in support of his idea. Indeed, so intimately has he been identified with the enterprise, success in which now appears to be within measurable distance of realization, and so energetically has he pushed it forward, that he has become regarded as the "Father of the Scottish rival to Panama."

CHARLES A. STEVENSON.
Eminent Scottish engineer who champions new waterway project.

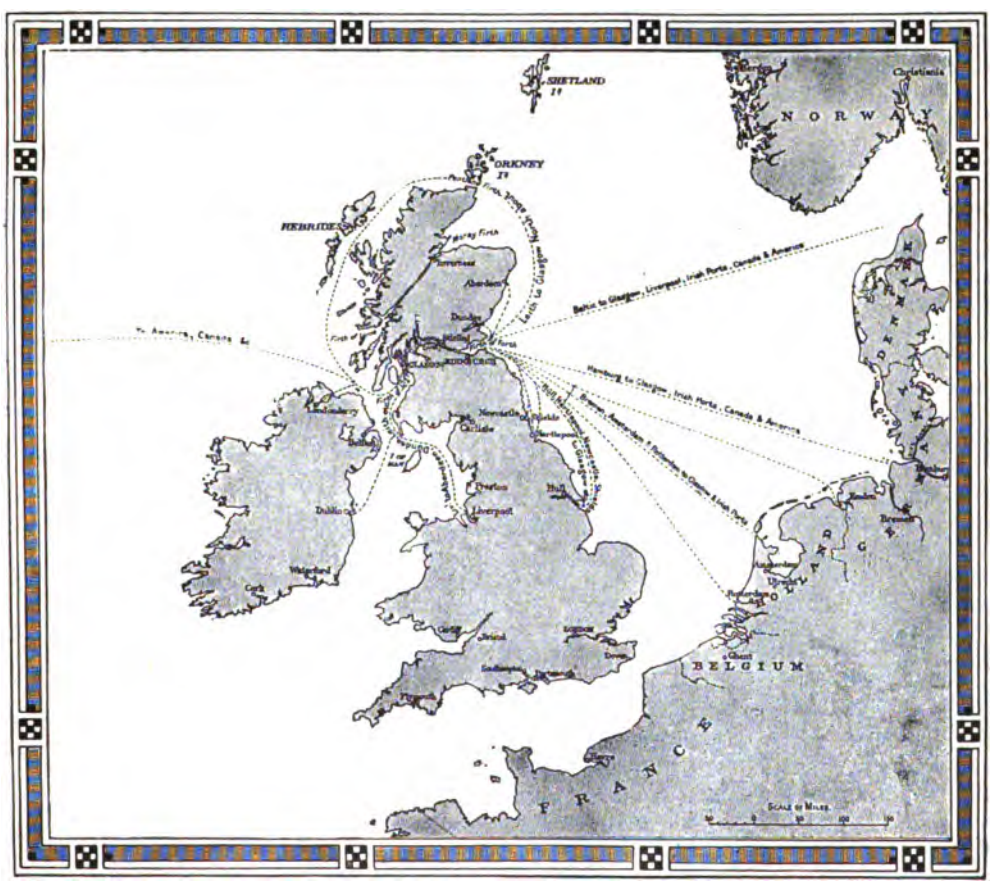
That the scheme has many points of attraction from the phlegmatic commercial point of view is testified by the fact that on four different occasions powerful financial syndicates have approached him with a view to carrying the project through. Three times have the engineers been over the ground plotting and leveling the route, and twice proceedings have been so advanced as to reach the stage of completing the plans and filing the estimate of costs with the Government in order to receive the requisite official ear-mark of approval.

But as inevitably results in such undertakings, the selection of the particular route by Messrs. Stevenson trod upon someone else's toes, and the project was bitterly assailed by a rival faction. These latter prosecuted an alternative route, which they claimed to be shorter, cheaper to construct, and more advantageous from every point of view. This scheme advocated the cutting of the ditch from the Firth of Forth and running more to the south of the Stevenson project, entering the Clyde at its upper reaches. This route was only attractive from its shorter mileage, involving less actual excavation, but on the other hand it had the defect of necessitating elaborate dredging in the Clyde to secure a navigable deep-water channel, and even once this waterway was adapted to such traffic, a vast amount of money would have had to be poured out every year in keeping the channel open, otherwise heavy silting-up would ensue.

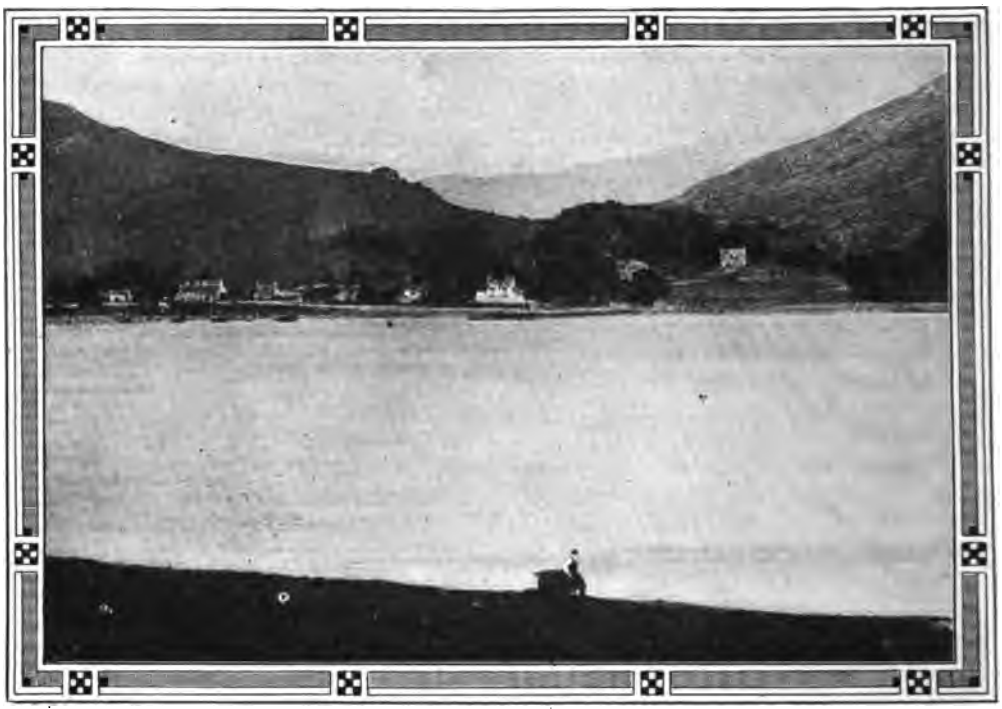
At first the superior features of the Stevenson canal was not apparent to aught but the foremost engineers. If you take the map of Scotland once more and draw a line across the narrowest portion as already indicated, you will observe just north of that line towards the western end, the waters of Loch Lomond. This lake is of great depth except for one or two places here and there, so that the largest vessels afloat could safely ride on its bosom. This inland sheet of water lies in a depression locked in by mountains, which rise rapidly to the north but the lake is gained through a narrow defile or valley hemmed in by a slight ridge. The opposite side of this range once gained, a broad expansive plain opens out continuing all the way to the banks of the Forth. This is the famous Plain of the Forth and the engineers as a result of their surveys emphatically declared that a causeway through this broad valley was the most feasible solution of the problem, the

waters of Loch Lomond also being pressed into service. True the route might be somewhat circuitous involving a greater mileage of artificial waterway, but such would cost less to build than if a route were carried through the more tumbled country to the south, for digging through rough steep ridges and filling up great depressions invariably runs away with the money.

When the government engineers came to investigate the schemes, however, they saw eye to eye with Messrs. Stevenson, and forthwith announced that the Loch Lomond route, as it was called, was that, and that only, which appealed to the Government. It is difficult to foretell exactly what result the provision of this waterway will exercise upon mercantile traffic, but inasmuch as water carriage is overwhelmingly cheaper than railroad transportation, and that the canal will offer a short cut between many of the great ports of Europe and England, as well as affecting the extensive coastal trade of the British Isles, financial success should not be beyond the realm of practicability. In the first place it must be remembered that there is a tremendous traffic around the north coast of Scotland, viâ the Pentland Firth, one of the most dangerous areas to navigation in Europe due to submerged rocks, narrow channels, fogs and storms. Indeed, this sea has almost as unsavory a reputation in Europe as that around Cape Hatteras on this side. Then again the west coast of Scotland owing to its broken iron bound character, exposed to the full fury of the Atlantic, has to be well steered clear of in dirty weather. To avoid the dangers incidental to this



MAP SHOWING SAVING IN DISTANCES BETWEEN VARIOUS PORTS AND COUNTRIES.



LOCH LOMOND, SHOWING IN THE DISTANCE THE RIDGE THROUGH WHICH THE CANAL WILL HAVE TO BE CUT.
This excavation will be the most difficult part of the whole project.

"north about" passage, as it is called, ships would undoubtedly prefer the sheltered route through the canal, even though it did entail a slight expenditure in tonnage dues, for the money expended in this direction would be more than recouped in the saving of time on the journey, and so many hours saved on a sea-passage represents just so much in the saving of coal, and a thousand and one other incidentals which aggregate a good round sum, while moreover the vessel would have just so many more days per year to do more passages, and thereby increase its earning capacity.

It may be safely asserted that the canal would favorably influence all that traffic from west of England ports between the Bristol Channel and Oban to the eastern coast of Great Britain and Europe. Much, of course, depends upon the relative geographical situations of the ports of departure and arrival, the saving in distance ranging from 100 to 500 miles. For instance 300 miles would be clipped off the journey between London and Glasgow, and a like amount between the Tyne ports and Glasgow; the journey between Glasgow and Copenhagen or Hamburg would be reduced by 380 miles, while that between the latter port and Liverpool would be a matter of 300 miles. In time this represents an economy of from one and one-half to two and one-half days as compared with that via the north of Scotland in fine weather, and should fog prevail then the latter passage might be easily spun out to three or four days. And the canal would exercise a decisive effect upon the transatlantic traffic between New York and northern Europe. A large number of vessels, especially tramps, travel via the north of Scotland, dropping round the north of Ireland to get into the usual high road of vessels across the Atlantic. To these vessels the presence of fogs in the more northern latitudes is a source of great anxiety and danger, and from time to time the world is startled by a terrible calamity, such as that which befell the Scandinavian emigrant ship off

Rockall to the extreme north of Scotland a few years ago, which serves to emphasize the dangers of these northern waters. To this traffic the canal would especially appeal as avoiding a roundabout route in favor of complete safety, and a saving of distance and time, as well as bringing several ports of call for picking up traffic on the way.

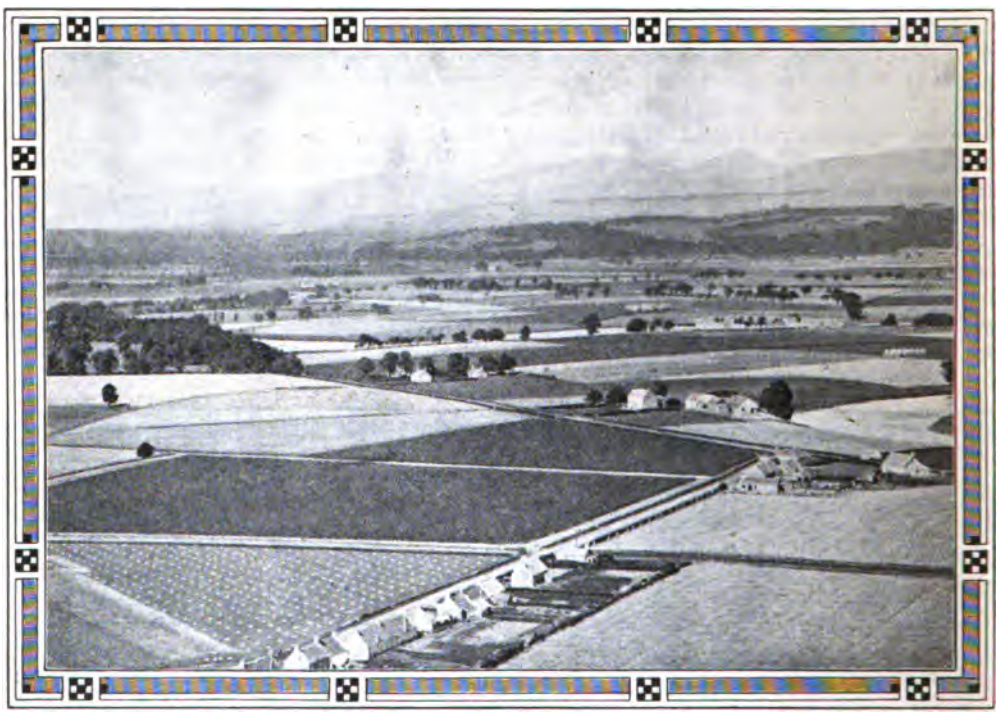
It is estimated that at least 10,724,805 tons of shipping per year is immediately available for the canal, according to the British Government returns—this excludes the European-American traffic—and the revenue accruing from this at an average of thirty-seven and one-half cents per ton would yield an annual gross revenue of $4,021,800 in round figures. Deducting $300,000 as the annual cost of maintenance and so forth, this would leave a net total of about $3,721,800 which would yield an interest of some three per cent. upon the estimated cost of the work.

This is exclusive of the income that would be derived from the Government, in return for the use of the canal by the Navy. This value it is impossible to pronounce as it would be incalculable in war. The existence of the canal would enable the admiralty to shift vessels from one side of the islands to the other in a few hours, as a fast battleship or torpedo boat could cut through the canal in about 5½ hours. The provision of the canal would more than safeguard the country. It is admitted that in a European war the scene of naval activity would be the North Sea, and in the event of a defeat for the British ships in that arena, when possibly the eastern repairing yards would be cut off, the disabled vessels would be able to get to the naval establishments on the west coast in a very short time. The canal will be to England what the Panama waterway will be to the United States in a war. Fleets and reinforcements could be changed from one side of the country to the other in the minimum of time and a concentration of forces effected, here or there, just as desired, while bottling up in the North Sea would be rendered far less remote.

THE FAMOUS STERLING CASTLE.
The projected canal will run through the land in the foreground.

The surveyors have thoroughly spied out the country to be traversed and have found the path of least resistance compatible with other requirements. The Forth would be left on the southern bank near Grangemouth, a short distance above Rosyth, the new British naval base. The canal would strike at once inland swinging through the tumbled country south of Stirling, and then breaking into the Valley of the Forth. At Grangemouth the vessels would be lifted by means of locks to the level of Loch Lomond, which is twenty-two feet above the mean level of the North Sea. Locks may be considered a disadvantage and that it would be better were the canal dug down to sea level, but unfortunately the tidal conditions on the Clyde and Forth are different and prevent the realization of such an idea, attractive though it be.

After winding for some miles through the Forth Valley the western end of this depression is gained, and here stands in the way the most serious obstacle—the haunch of Ben Lomond. The ridge rises very abruptly and to get through it will entail a cut of two hundred and sixty feet in depth. But though deep, the cut is short, and then the canal will emerge into another valley which is followed until Loch Lomond is entered. The waters of this inland sea are followed for a matter of thirteen miles to Tarbet near its most northern extremity. Here as a glance at the map will show the Loch is only cut off from Loch Long open to the sea by a mere thread of land one and three-fourths miles thick. True it runs to an elevation of one hundred and sixty feet at one point, but excavating through that would not entail prodigious labor, and then Loch Long is gained at Arrochar. Here the vessels will be lowered by means of a lock to the level of the sea in Loch Long, the deep waters of which are followed southwards until at last the Clyde is entered opposite the Cloch Lighthouse.



THE VALLEY OF THE FORTH THROUGH WHICH THE CANAL WILL PASS.

One very great recommendatory feature of this route is that the meandering

River Forth is left well on one side so that none of those troubles incidental to the deviation of such a river, as have been experienced at Panama where the channel of the Chagres has had to be diverted, will be encountered. In fact there will be no deviations whatever except that of a small streamlet. Neither is there any serious interference with highroads or railroads. Again the route will enable every type of vessel to pass through the canal without entailing shortening of the masts such as is necessary upon some ditches of this character. The heaviest pieces of work are the cuts through a ridge rising to 191 feet at Stirling, another of two hundred and eighty-five feet at the head of the Forth Valley, and a third between Tarbet and Arrochar, which notches one hundred and forty-two feet in height. But in every instance the cut is a very short one.

The canal will have a bottom width of one hundred and forty-eight feet, though originally one hundred feet was decided upon. The Admiralty however promised assistance only if the first named width were adopted. The locks are to be nine hundred feet in length to carry the largest vessels afloat, by one hundred feet in width and the depth of water in the ditch will be thirty-six feet. In building the canal it will be necessary to excavate 170,000,000 cubic yards of spoil. The extent of artificial waterway would be thirty miles, for although the total length of the canal would be fifty-one nautical miles, of this twenty-one miles would be in open water as represented by Lochs Lomond and Long. The cost of the undertaking is put at $122,000,000 and this is a liberal estimate, the borings, and measurements having been carried out very carefully and extensively. It is anticipated that the work will occupy some seven years to complete. The more enthusiastic set a shorter period.

POISONS AS SERVANTS OF MAN

By

J. EMILE BLOMEN

THE idea of a poison is generally associated with excruciating pain, a hospital cot and lingering death; but, when the mind turns to cyanide of potassium, instant death looms up for the imagination.

So treacherous and terrible is the poisonous nature of this innocent-looking, candylike substance, that even the poison-expert handles it with reluctance. And there is a reason, for unlike the other life destroyers he is so familiar with, he only needs to get this one in an unprotected wound in his hand or intake some of its sweet, bitter almond smelling vapors to be a corpse. Indeed, he would think nothing of chloroforming a dozen cats or of scattering strychnine and arsenic broadcast by the pound, but, when it comes to cyanide of potassium, he literally "handles it with gloves."

Carbolic acid, opium, arsenic, strychnia and other poisons have become familiar terms to the general public, but of cyanide of potassium it hears but seldom, except, when now and then a rogue elephant is to be executed. You may feed arsenic, nux vomica, morphia or the like by the shovelful to one of these 6-ton pachyderms without doing anything but causing it intense agony or nausea, yet a stick of this cyanide one inch in length and no thicker than an ordinary lead pencil will kill the colossus as quick as if death itself had opened its gape and swallowed it. The poison is hidden within an appetizing carrot, the gigantic trunk reaches forth, grasps the dangerous morsel and into the huge mouth goes the death-dealing pill.

A surprised and accusing look comes into the little dark eyes, the trunk makes a few feeble swings and with a couple

THE DEADLY CYANIDE IN THE LUMP FORM.

of shudders of the massive hide the immense mass of animal vitality sinks into a heap of inanimate matter.

Gruesome and terrible as is this poison, yet our civilization would hardly do without it, if it could, for it has, indeed, proved itself a most valuable servant of mankind.

The alluring gold, that has been lying so teasingly near our grasp in mountain high heaps of ores in such a form, that we could not reach it by our ordinary means, has been reached and fetched out by cyanide of potassium, which has thereby enriched mankind by manifold billions. The gold-plated watches and rings you see in the jewelers' windows, the bright silver-plated wares on your table and sideboard, the many gold and silver-plated ornaments in the art shops, the very nickel-plated handlebars and bells and lamps on your bicycle owe their existence more or less directly to this assiduous poison. Every time you have your picture taken, it is done by the assistance of this magical chemical. From this deadly substance we obtain the fine blue colors, Prussian blue, and others, which are so valuable accessories to the dyeing, paint, color and ink industries. The assayer and analytical chemist would almost have to go out of business were it not for this powerful reagent.

Last, but not least, is the inestimable service this interesting chemical has rendered the science of chemistry, for by the study of its combinations and nature organic chemistry was made a science and a bridge was spun between the inorganic and organic kingdoms of nature.

Deadly as is this frightful poison, it is the least complex of all the poisonous substances we know of, for it only contains equal parts of three of the most common of the chemicals, with which we meet in our daily life.

Carbon, that chemical, which furnishes our fuel as well as our diamonds, nitrogen, which makes up three-fourths of our atmosphere without being of any direct use to our system but without which we would die as quickly as fishes out of water and potassium, whose innumerable compounds we meet with in our soaps, saltpeter, in fact everywhere we turn in our daily life—that is all that enters in this most formidable and deadly of poisons.

The elements making up cyanide of potassium being common the ingredients used in its manufacture are of the most simple nature; in fact they are of the lowest and most humble kind. Hoofs and horns from carcasses, slaughter-house refuse, old shoes and leather, together with such iron scraps as the sweepings from the floors of foundries and machine shops and the crudest kind of potash—that is all that is necessary to produce this, the most deadly of poisons and most efficient creator of mighty wealth.

Ordinary as are the elements composing it, common as is the material from which it is made, so is the process by which it is produced of the simplest kind. In fact you could easily manufacture it on your kitchen stove, only—you would rather not. You begin by melting the crude potash in a gigantic, pear-shaped retort set in a furnace which is kept at a good red heat. Then the cut up and dried charge of dead horses and dogs,

old boots, refuse, rusty iron nails and iron scraps of every conceivable variety is shoveled into the molten potash. As the shovelful of the well mixed organic refuse and rusty iron falls into the powerful liquid, a single drop of which would burn a hole through your hand, a hissing, sizzling, almost mournful sound, is heard and beautifully colored flames leap up from the kettle in shades of green and blue and red and yellow. When these flames cease to come forth, we know it is time to stop the shoveling. In fact that is the only indication we know of that the reaction is complete, for this process is based on experience only and science tells us but little of what takes place in that mysterious kettle.

The heavy, tar-like liquid in the huge iron pot, where the refuse from the organic kingdom has been blended with the offal from the inorganic world, now contains a number of more or less—particularly less!—known chemical compounds but mostly cyanide of potassium. Knowing its deadly contents you would be mostly inclined to call it "the devil's soup," but the man, who ladles it out, calls it "the metal" and, when it cools down, it is certainly hard and strong as a metal. The cyanide of potassium is extracted from this metal and all its chemical preparations are made from it. It is broken up and boiled with water, when beautiful, large crystals of yellow crystals—yellow prussiate of potash—is obtained. These are placed in an iron pot, when pure cyanide of potassium is obtained by extraction with water or alcohol.

It crystallizes out as a strong, milk-white, candy-like mass, which is broken up in lumps. This is the form in which it is generally met in the market, except when wanted chemically pure, when it is fused and cast in sticks.

If cyanide of potassium is the king of the poisons, gold has always held that proud position amongst the metal. The reason for this is, that it is not affected by any of the ordinary acids. You may dip it in the strongest muriatic acid or steep it in fuming nitric acid and it will come out brighter than when put in. It is only when you combine these two acids that you can dissolve the gold. This combination has for that very reason got the name of "agua regia" or "royal water," and it was effectively used in all kinds of tricks and hokus-pokuses by the ancient but not venerable alchemists.

Is it not peculiar then, that the chemically weak, life-destroyer cyanide of potassium should dissolve the chemically all-resisting, soul-destroyer, gold, as quickly as gasoline will eradicate a grease spot? Yet this is the case and hence its immense usefulness to the gold-production of the world.

The only four effective solvents, we know of for gold are lead, mercury, chloride and cyanide of potassium; of these lead has but a limited use, because it is a solid at ordinary temperature and chloride because it is a gas. Mercury is such a heavy and unwieldly liquid, that it is exceedingly difficult to make it reach every part of the cold carrying ores. Furthermore, it only affects free ore, as it is called, "native" gold, and has no effect on the numerous gold compounds met with in mining. These must, therefore, be transformed to gold

CYANIDE POTASSIUM IN ITS POWDERED FORM.
Cyanide is a poison that very quickly destroys life.

by other means, before the mercury can extract the gold. A solution of cyanide of potassium, on the other hand, can reach every particle of the crushed ores and it will dissolve not only free gold but also almost every other form, in which gold is found.

The process for gold extraction by means of cyanide of potassium is briefly as follows: The crushed ore is agitated in large vats with a solution of the cyanide, the solution is then drawn into other vats which have thin sheets of lead at the bottom. The lead serves as one pole of an electric current, and iron plates make up the other pole. When the current is turned on the gold is precipitated on the lead, which immediately absorbs it. This precipitation of the gold is continued until the lead is saturated, when the gold-laden lead sheets are taken out and the gold regained by melting.

By this method untold millions have been extracted from gold ores which, until the use of this "cyanide process" had been considered unprofitable.

The peculiar characteristic of cyanide of potassium to form various compounds with gold, silver and other metals is most extensively made use of in the electroplating and gilding industries, and the preparation of the gilders' salt is as interesting as it is dangerous, for in this process you meet with a chain of chemical evolutions, including a most violent explosive, the deadliest of poisons and the most mysterious of the natural forces to each in an evenly distributed deposition of the most precious of common metals.

There are very few chemical processes in which chemicals act upon each other in the dry and solid state and, even in these few instances, you generally have to liquefy the solids by heat. Even the wily alchemist of ye olden time knew that he had to have his chemicals in solutions to make them react readily upon each other and he therefore sought for proper solvents for everything he met with in the line of chemical reagents. He had considerable difficulty with the elusive yellow metal, gold, in this respect, until he found his "royal water." This mechanical mixture of acids, which have only a very slight action on each other, has the property of dissolving gold as long as the muriatic acid in the mixture has any chloride left in it.

The first step in the preparation of gilder's salt is to dissolve gold in "royal water," *i. e.*, a mixture of muriatic and nitric acids. The ammonia water that counterbalances, neutralizes and acts as enemy of all acids, is added gradually for the reaction is most violent, and the fumes given off are most obnoxious and deadly. When at last the reaction is over and all fumes but that of pure ammonia have ceased, you have clear liquid, at the bottom of which you will find a fine, heavy, dirty yellowish powder, which is chemically known as fulminate of gold.

Now, a miner may show as much contempt for and indifference to the dangers of the dynamite or other explosives he handles, but he always treats his fulmination caps with the utmost respect and reverence, just because they contain fulminate. Still the fulminate of mercury in his caps is not such a sensitive and treacherous explosive as its aristocratic brother the fulminate of gold. It is therefore with the utmost caution you handle your dirty yellowish fulminate powder, while you wash it to cleanse it from adherent acids and ammonia salts, carefully observing never to get it dry, for, if you did and it should get the least kind of a blow, it would instantly eradicate you from the face of the earth.

This most formidable, death-dealing explosive is now dissolved in a solution of the deadliest of poisons, cyanide of potassium. In a little while you will have a clear pale yellow solution, which, if rightly made, is neither poisonous nor explosive, and which, after concentration and cooling yields beautiful crystals of gilder's salt.

If you dissolve this in water and pass an electric current through the solution you can cover any desired object with an even coat of the finest gold.

The metallic cyanide compounds are most sensitive to the decomposing effect of even the weakest electric current, and not only cyanide of gold but also those of silver, copper and nickel are extensilvely used in the electroplating industry.

Cyanide of potassium is a splendid sol-

WEIGHING THE DEADLY CYANIDE.
This chemical has many uses in the industries.

vent for the chlorides, bromides and iodides of silver and, is for this reason almost indispensable in photography.

Although cyanide of potassium is so important in the extraction of gold, in the electro-chemical industries and in photography, these were not the fields in which it first was used.

In this case, as in so many others, we have the humane love for bright and glittering colors to thank for industrial evolution, for the products from the impure cyanide of potassium, "the metal" above spoken of, were used by the dyers and color-manufacturers long before it was thought of for any other purposes or its real composition and nature was known.

It has already been said, that, when the mixtures of impure cyanide of potassium and iron compounds in "the metal," is treated with boiling water, yellow prussiate is formed. By treating this compound with other compounds of iron, the colors Prussian blue and Turnbulls blue as well as the beautiful red prussiate are formed. In these forms the cyanides are very widely used in the calico prints or dyeing, color and paint industries and in ink manufacture.

Cyanide of potassium can form a greater variety of complex chemical combinations with metals in general and precious metals in particular, than almost any other chemical reagent used in the laboratories. It forms characteristic and easily recognized chemical compounds with iron, nickel, copper, zinc, lead, silver and gold, and in many cases the free metals can be produced from their cyanide compounds simply by reduction by heat. For this reason it is indispensable in the assayer's office and it makes a most valuable detector in qualitative investigation and weigher in quantitative determinations in the hands of the expert analytical chemist.

When in the later part of the eighteenth century chemistry began to emerge from the shadows of mysticism and to

pass from the hands of the tricky alchemists to those of more sincere investigators, the only part of the science which was considered legitimate knowledge was inorganic or mineralogical chemistry. The existence of a large number of elements had been recognized and their combinations studied, but organic substances were reverently left alone as obeying only some ungraspable, mystic influence called "the vital force," and carefully exempt from experimental and synthetical research.

It was while investigating the compounds from that crude cyanide of potassium, "The metal," that Wöhler, one of the most celebrated pupils of the great master, Bergelius, found "the missing link" between the inorganic and organic chemistry.

Cyanide of potassium is, as its name implies, composed of potassium and cyanogen, which latter is a simple combination of the elements carbon and nitrogen. In the year 1828 Professor Wöhler produced from this cyanogen the substance urea, which, beyond any question or doubt belonged to the organic kingdom of nature and by this discovery a bridge was built between the inorganic and the organic realities of nature and organic chemistry was founded as a veritable natural science, truly belonging to the domain of experimental researches and empirical knowledge.

From purely inorganic, "lifeless" materia had been obtained an integral part of organic "life" and Professor Bergelius, who in a greater degree than even most scientific men was skeptical in his acceptance of and cautious in his expectations in new discoveries, hailed this scientific victory over matter with enthusiasm as the beginning of a new era for his beloved science and proposed for Urea the name of "Orthevite," as indicating that with it had come the dawn of a new science.

Professors Wöhler and Liebig and their pupils eagerly continued the investigation of these offsprings of deadliest of poisons, Cyanide of potassium and thereby launched Organic Chemistry on its remarkable course of usefulness in our daily industrial life.

It is worth remembering, that the study and investigation of this, the deadliest of all known solids, had never, by accident, craved the life of any of its forerunners.

STATE WILL FARM ITS ROADS

By

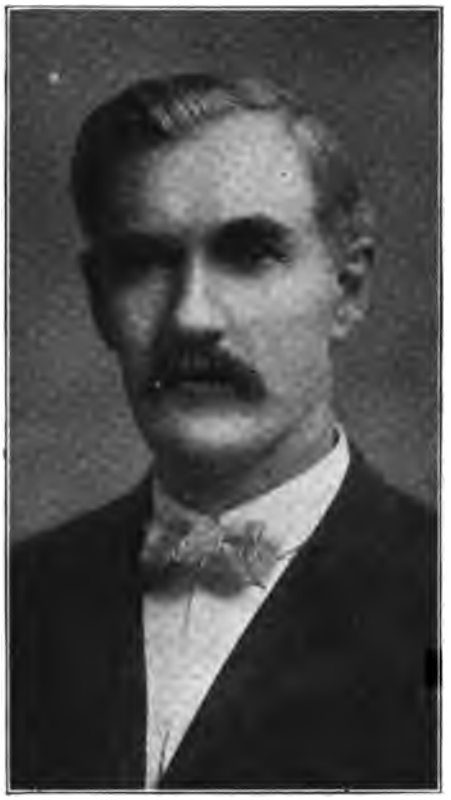
F. G. MOORHEAD

GOVERNOR B. F. CARROLL of Iowa proposes to add eight and one-half million bushels of corn to the annual crop of his state simply by lopping ten feet off each side of the average country road. He believes that a highway forty feet wide, instead of sixty, would be ample for all requirements, could be more easily and more cheaply kept in good condition and argues that the unnecessary twenty feet of land if returned to cultivation would mean four and three-quarter million dollars added to the wealth of the state each year, $3 for every man, woman and child in its borders.

The governor outlined his plan before the recent convention of the Iowa Implement Dealers' Association. The average country road, he pointed out, is sixty feet wide, whereas forty feet is sufficient. The result is that the middle and sides of the road grow up in weeds and make unsightly highways, the two channels of traffic being separated and bordered by unused and unsightly weed rows and ditches. "This twenty feet of land might far better be tilled and be producing wheat and corn," urged the governor.

A little investigation discloses the possibilities of Governor Carroll's plan, not only for Iowa but for all agricultural states. There are 100,000 miles of

country roads in Iowa. This equals 800,000 acres of land. Some of these roads are main arteries of communication and transportation, others are little more than lanes, weed choked and rutty. The Iowa road law requires a highway to be at least forty feet wide and never more than sixty-six feet. The average width is sixty feet. Governor Carroll's plan to reduce the width from sixty to forty feet would result in cutting down the number of acres devoted to roadway by one-third, a total of 266,667 acres. Assuming $100 to be a fair average price for Iowa farm land—hundreds of farms are being sold at $150 to $200 an acre—the land thus restored to farming would be worth $26,666,670. Assuming the annual net revenue per acre in Iowa to be $15—another conservative figure—and the yearly income from the restored land would be $4,000,000.



GOVERNOR B. F. CARROLL, OF IOWA, WHO SUGGESTS THAT IOWA RECLAIM NEARLY A MILLION ACRES BY NARROWING ITS ROADS.

If the land thus removed from disuse and restored to cultivation were devoted to corn and grew only the average for the entire state, 32.4 bushels to the acre, it would yield 8,640,000 bushels, as much corn as is raised altogether in the six states of Maine, New Hampshire, Vermont, Massachusetts, Connecticut and California. This increment, sold at the average winter price of fifty-five cents a bushel, would bring to the farmers of Iowa $4,762,000, an amount more than sufficient to pay the running expenses of the state government. But there is good reason to believe that the converted roadways would be more fertile than the average adjacent farm land and would return far larger yields than the state average. This land has had a rest from tillage for many years. It has rested up and has added to it the fertilization resulting from the constant passing back and forth of farm animals. The elements of fertility have been restored. It is highly probable that for the first few seasons, at least, the state average would be doubled on these strips of land. One Iowa farmer in 1909 raised 153 bushels of corn to the acre. Over a score raised more than seventy-five bushels to the acre. The state record was formerly held by a farmer who made up an acre in area by taking a narrow strip at the base of a hill down which the rains had carried fertilizers until the strip at the base was as rich as the Vesuvian fields. The converted roadways would furnish similar strips of highly fertilized land on which the state average yield could easily be doubled, resulting in an annual increase of no less than 17,200,000 bushels of corn, of an average winter value of $9,524,000. And all this without the introduction of any new farming methods or the discovery of any new agronomic principles.

The implement dealers of the state are heartily in favor of the general proposition, but instead of giving the unused strip of roadway to the farmers whose property adjoins they propose renting it, the proceeds to go toward keeping the remaining forty-foot roadway in good repair. The governor would provide for maintenance by diverting 30 per cent. of the state road

BROAD HIGHWAYS RENDER FARMERS INDIFFERENT TO REPAIRS OWING TO THE EXPENSE

A FORTY-FOOT ROADWAY SUCH AS THIS IS KEPT MORE EASILY IN REPAIR.

tax of four mills to road dragging. He pleads for more dragging and less grading. "I am firmly convinced that it does a road more harm to grade than it does to leave it alone," he asserts. "Of course, a certain amount of grading is necessary, but I have reference to making them level and smooth. Dragging for that purpose is much better."

This problem of disposing of the unused ground has been put to one of the best posted legal authorities of the state who has handed down this written opinion:

"The governor is unquestionably correct as to the proper disposal of the strips of ground to be taken from the roadways. No other lawful disposition of this land could possibly be made, where the roads have been established in the regular way. The opening of a public road by legal proceedings in Iowa does not confer on the public the ownership of the ground occupied by the road, —but only an easement in it—the right to use it as a public highway, to pass and repass over it. The fee in the soil remains in the owner of the land over which the road is located. He retains all rights as owner, subject, however, to the right of the public to travel over it and keep it fitted for that purpose. When, therefore, the public abandons the ground or any part of it, as a public highway, the ground so abandoned is at once relieved from the burden or easement to which it was subjected, and the full rights of absolute ownership become alive in the owner, by operation of law. In such a case neither state, county nor township has any right to sell or rent the abandoned ground. The right of the public to it ceases and comes to an end when it is abandoned for highway purposes and the owner of the land to which it originally belonged can lawfully claim possession of it."

Governor Carroll's proposition is receiving careful consideration and will probably come up for discussion at the next session of the legislature. It is doubtful, however, if any legislative action is necessary. The Iowa law reads: "Roads hereafter established, unless otherwise fixed by the board, shall be at least sixty-six feet wide and in no case less than forty; within those limits they may be increased or diminished in width, altered in direction or vacated by pursuing the course herein prescribed." The course prescribed is by petition to the board of supervisors, which is the governing body. Each county is, therefore, a law unto itself, except that a minimum of forty feet is insisted upon. Governor Carroll believes that there are places, especially in hilly regions, where the present wide roads are necessary, but he is convinced that in the great majority of cases the roads are wider than necessity demands and economy warrants. Once he can convince the various supervisoral boards of the financial possibilities of restoring the unused roadway to tillage his task is finished, and progress is being made.

EARTHQUAKE PROOF HOUSES

By

EDWARD I. PRATT

THE ravages of fire due to the massing together of buildings in all of our cities; and the rapid growth of cities and towns everywhere, has made the demand for fireproof structures an insistent one. Before the use of concrete became general real fireproof construction was most expensive and could be used only in the larger buildings with high rentals.

The ordinary method of reinforced cement construction is not widely used in smaller buildings, residences, stores and flats, and the continued demand for a lighter form of reinforced concrete

How the Corners are Braced.
Iron piping with malleable bolt attachment.

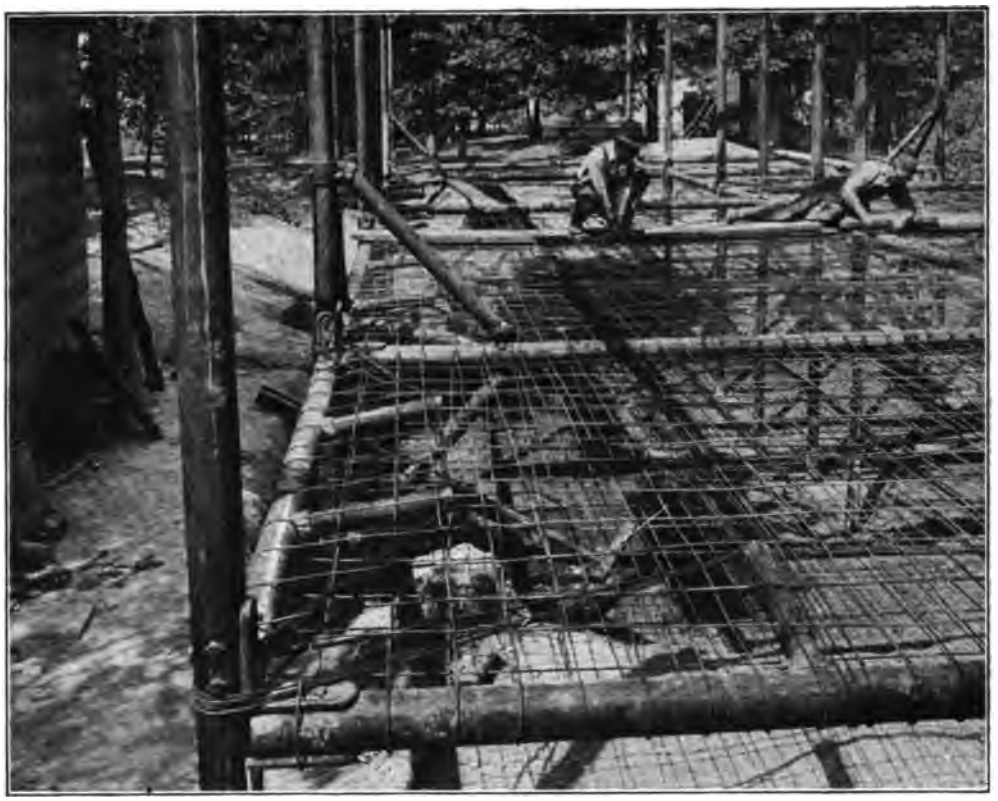
building, absolutely fireproof and suitable for structures of moderate size has led to the invention of an altogether new method which promises to revolutionize building.

The scheme is simplicity itself: Steel tubing, filled with concrete, and wire are used for the frame. Upon this skeleton the concrete house is built. Except for the foundations and piers, the concrete does not carry any of the load. However, the cement walls, floors and roof when hardened, form a body that is rigid, of great strength, indestructible and vermin proof.

It is claimed that this form of concrete reinforcing will withstand heavy earthquake shocks. Mr. George M. Graham is the inventor of this spiderweb house building. Six inch piping, wire, malleable fittings and cement are the materials used. No forms or moulds are needed.

The frame in process of construction reminds one of some huge mastodon skeleton, held together by the weblike wires, which are strung at a tension of one thousand pounds. Further points of superiority of this steel suspension are that, besides doing away with forms and centering, which is a great advantage over older methods of reinforced concrete construction, the floors and walls

Vertical Wiring, and Wire for Plaster, in Concrete House.



THE METHOD OF TRUSSING AND WIRING.

are hollow which affords good insulation and reduces the weight to the lowest practical point; also the walls, floors and partitions harden into one mass so that the building is vermin proof and because of the interlacing wires everywhere, cracks cannot develop.

All steel and wire is enclosed in cement, preventing corrosion, the main frame piping being filled with cement. No bolts or any parts of the metal are exposed to the air. The exterior surface being of cement mortar, any style of finish or form of ornamentation can be employed.

In constructing a building by this method all pipe is cut and drilled before erecting. The pieces are put together with malleable iron fittings, no thread joints being used. These fittings are bolted through columns and girders.

This is all simple work and can be done by common labor. Much less time is needed than in ordinary construction, as it is only necessary to hoist the pipes and bolt them together. Afterwards they are filled with concrete. The girders are filled with cement before being put in place, the bolt fittings being already attached. This filling greatly increases the strength of the pipe and protects the inner surface and bolt heads from rusting.

As shown in the illustrations, the floors are formed by wires, which are drawn taut. Contractors claim that this method of using steel under tension embedded in concrete is the best way in which the two can be combined.

Tests have proved that an equivalent amount of steel used in this fashion makes a flooring almost double the strength of other forms of reinforcing. The number of wires used in the flooring depends upon the weight to be carried. As the iron pipe frame is put in place trusses are set horizontally, made up of several strands of wire and short pieces

THIS RESIDENCE IS GUARANTEED AGAINST EARTHQUAKE.
It is constructed on the steel suspension method.

of pipe. This bracing counteracts any effect of the strain caused by the pull of the wires in floors or walls. In the same way the downward strain on each horizontal girder is carried by the girder above it.

Number 0 to number 3 wire are used, and are drawn around the horizontal tubing so that there is a double row of wires for the flooring and a double row of vertical wires for the walls. The floor wiring is strung lengthwise and crosswise in the building and is held in place by short couplers connecting the upper and lower strands as they are bound around the main frame. This scheme of floor and wall construction is shown in the photographs. The window frames are secured to the wires with the same kind of couplers used in the floor work.

Wire cloth or expanded metal is placed under the top wires of the floors, tied to those wires and upon this the concrete body and surfacing is placed. The floor wiring being wound free around the horizontal girders adjusts itself to the weight of the concrete without strain. The same metal cloth is secured to the lower or under matting of floor wiring and the ceiling plaster applied to the expanded metal, and the ceiling finished in the ordinary way. With spans of from fourteen to sixteen feet, the concrete is laid three inches in thickness.

The wire cloth is attached to the vertical wires in the same way and cement plaster used for the outside wall covering. Partitions are wired and finished similarly and can be made double with air space between as in the walls and flooring or built with a single row of wires with the expanded metal stretched on both sides on which to plaster. The roof is built on exactly the same principle as the flooring.

METALS THAT TAKE FIRE

By

DR. ALFRED GRADENWITZ

BARON AUER VON WELSBACH, the famous inventor of the incandescent gas lamp, some years ago made the interesting discovery that the metals of the rare earths, of which incandescent mantles are composed, are imparted a capacity of igniting of their own accord by a slight addition of other metals—especially iron. In fact, the alloy thus produced will give out sparks on being rubbed with a file, and this sparking becomes more intense as the iron content increases, gradually assuming the aspect of a brilliant light spray. An alloy containing about thirty per cent iron has become so sensitive as to give out intense sparks on a slight contact with an iron tool.

THE SELF-IGNITING LAMP LOWERED TO STREET.

Welcome features of these alloys are their nearly perfect non-oxidability as well as their hardness and brittleness. It has further been found that the extremely minute particles detached already by a slight friction are able to light safely and practically instantaneously, any combustible gases or other inflammable objects, such as a wick soaked in alcohol or benzine. If the alloy be put to higher strains, as on severing larger fragments, intensely brilliant flames apparently of hand size, are formed, which, strange to say, are attended by only a slight production of heat and smoke. These phenomena obviously suggested the idea of utilizing for technical purposes the spontaneous formation of sparks and flames. A self-igniting gas burner can be obtained by connecting with the tip of an ordinary incandescent gas burner some convenient device for producing sparks on a fragment of such alloy as the cock is turned open. An alloy consisting of sixty per cent cerium, ten per cent rare earth and thirty per cent iron, for instance, lends itself for an excellent spark production and can be produced so cheaply that an igniting rod susceptible of some hundreds of ignitions is obtained at a cost of about half a dollar.

Attempts have actually been made already to utilize a similar method for the ignition of mining lamps, as well as in the form of pocket brickets. A very interesting application of the same method has, however, been made by Mr. H. Wunderlich, Director of the Karlsbad Gas Works, for lighting street lamps by the aid of similar ignition devices. In fact, the designing of prac-

THE SELF-IGNITING LAMP IN POSITION.

THE LAMP ITSELF.

tical igniters for gas flames, both for house and street lighting, is one of the most important improvements of gas engineering, as the handling with matches and alcohol lamps is the main drawback of gas lamps in their competition with electric lamps, though these, in most cases, are far less economical.

The diagram represents schematically the arrangement of a five-flame inverted gas mantle lamp for street lighting, designed according to the Wunderlich system. As the explosion chamber 21 is mounted, not inside the lamp but above the percussion tube 18, any existing lamps can be readily equipped with the ignition device. As in the case of ordinary ignition, the gas penetrates after opening the gas cock, through the small tube 19, to the center of the lamp, in order there to issue through minute holes, and after ignition to be carried in the form of extensive pointed flames to each of the burners, thus igniting the latter in their turn. However, one of the openings terminates below the percussion tube mentioned so as to cause an explosive mixture of gas and air to rise in the latter as the cock is opened. In the case of ordinary ignition, this explosive mixture is ignited by a lighting lamp causing the flame to strike downwards and to ignite the lighting flames.

Now, this ignition is effected quite automatically by the use of self-lighting metal alloys. By moving down the lever arm 14 which disengages the passage to the percussion tube 18 as well as the main gas conduit, the bolt 17 is moved downward through the intermediary of a lever system 15. This bolt, in connection with a cam, throws downward a click and lifts a metal sector. As the bolt moves farther down, the cam again disengages the click, while the sector is thrown downward by a spring thus pressing a rod of inflammable metal against the coarse periphery of the sector and generating a violent sparking, which effects the ignition of the explosive mixture.

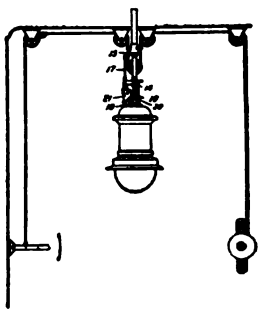


DIAGRAM SHOWING THE MECHANICAL ARRANGEMENT OF THE PARTS.

Fig. 2 represents an outside view of a lamp equipped with this ingenious device, and Fig. 3 shows a street lamp which, as seen from the figure, is provided with pulleys and string for raising and lowering it, in the same way as an electric lamp.

AN ELECTRIC MARY ANN

By

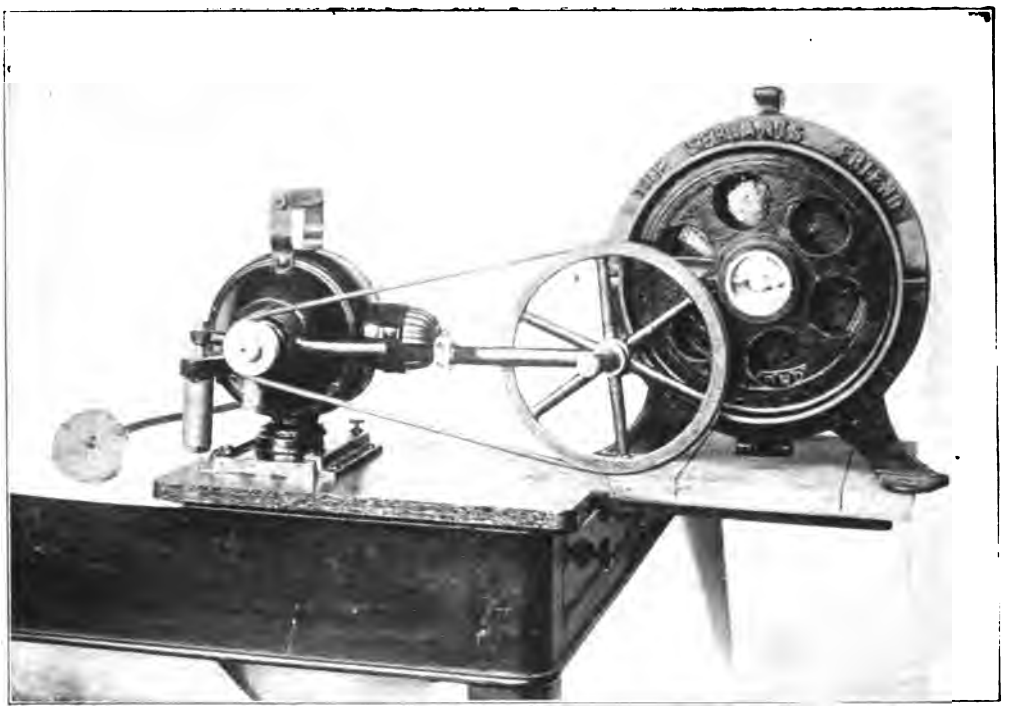
CHARLES R. BENNINGTON

THE servant problem is the great perplexity of domestic bliss that baffles all attempts at solution, as least by ordinary methods. But a well-known English electrical consulting engineer, Mr. R. Borlase Matthews, A. M. I. C. E., A. M. I. E. E., has come to the rescue in the designing of a handy convenient, and powerful little motor, which will relieve the good house-wife of her greatest trouble. Many efforts to mitigate household duties by electrical means have been attempted, and a certain measure of success has been achieved. One and all, however, suffered from the common disadvantage—the motor had to be fixed, and consequently had to be attached to one machine, such as a knife cleaner, a coffee mill, or what not, so that although the motors were made very small and inexpensive, still their acquisition involved a considerable capital expenditure.

Mr. Borlase Matthews, however, has now altered all that. He has devised a novel little machine which is portable, and can be connected up to any type of household machine, in a few seconds, with the minimum of trouble. The motor is self-enclosed and is fitted with a handle by which it can be carried. From one side projects a horizontal shaft with one end fixed to the motor casing at the armature bearing. The outer end of this arm has a large pulley driven by belting from the small pulley mounted on the motor shaft. The axle of the large pulley on one side is so arranged as to give a friction drive. The motor is complete with switch and carries a short length of flexible wire and a bayonet joint so as to fit the ordinary electric lamp socket. Weighing only seventeen pounds complete, the motor can be carried from room to room, as desired, with ease. For greater convenience the motor is mounted on a small base board, being slid into grooves to secure a firm foundation. For ordinary kitchen purposes the motor can be left on this base board, the various utensils which it is to drive being clamped on to the other end of the base-board as shown. When desired for use in some other room the motor is simply pushed sideways out of the groove and can then be easily carried in one hand by means of the handle.

THE MECHANICAL "MARY ANN" CLEANS SHOES.

The work which this little contrivance can accomplish is endless in its variety. The knives want cleaning. The motor is mounted on its base board and the knife machine clamped on the other end. To transmit the requisite rotary energy to such machine there is a special rim pulley provided, which is attached to the machine in a few seconds. The nut on the shaft of the knife cleaner, coffee grinder, and so forth is released, this rim pulley slipped on and the wing-nut replaced. The knife machine is then set so that the friction drive on the large motor pulley wheel engages with the rim of the knife cleaning machine. An electric lamp is then detached from its socket and the motor plug slipped in. The switch is turned on and lo! the knife cleaner whizzes round with a merry hum, furbishing the knives with lightning-like rapidity, and with less danger of inflicting damage to the cutlery



DRIVING A KNIFE CLEANER.
At the side is the flexible shaft and rotary pad for polishing.

than prevails when cleaned by human agency owing to the uniform steady drive and the absence of jerks and shocks. The knives cleaned, the coffee-mill, mincer, potato peeler, dough-mixer, ice cream freezer, egg-whip, raisin stoner or what not is coupled up in the same manner, and work that would occupy the human Mary Ann an incalculable length of time is satisfactorily accomplished in a few seconds. The problem is simply resolved to the coupling up of the machine, keeping the utensil being driven supplied with material, and switching the current on and off. No physical exertion whatever.

Then the boots require cleaning. For this purpose a small flexible shaft having a circular brush is slipped upon the axle. The operator holds the boot in one hand, and gripping the barrel of the rotary brush in the other whisks it quickly over the boot, first removing the dust. A second in disconnecting the brush for mounting, another for applying the polish, and another similar change to impart the final polishing, and a boot is given a mirror like polish in a few seconds. In establishments and schools where the boot cleaning undertaking runs into dozens or hundreds of pairs per day, by means of the Electric Mary Ann the task can be completed in a tenth of the time occupied by hand. Similarly the same arrangement can be adapted to plate cleaning, and will clean spoons, forks, cruets, biscuit boxes, or what not, irrespective of the nature of the metal with magical speed, the only manual effort involved being the guiding of the whirling polishing brush. When the grate requires furbishing it is only necessary to place the motor on the floor, a chair, or table near the grate and one of the dirtiest operations in the house can be quickly accomplished without soiling the hands, the most elusive and difficult corners being scoured as readily as the plane surfaces. To complete the cleaning of the room the motor is simply coupled up to the vacuum cleaner and dust is torn at amazing speed from carpets, chairs, wall-papers, curtains and other decorative articles and removed entirely.

Nor is this the limit of its usefulness. Carried into the scullery it is coupled up to the rotary washing machine and hours of continuous and exhausting labor are saved. The machine requires no attention and can be left faithfully performing its task while the *frau* is intent upon other work. The washing completed the heavy wringer next comes under the motor's attention and is soon whirling away squeezing the superfluous water out of the clothes it was so zealously agitating in the washing machine but a short time before.

When the ordinary day's duties are fulfilled the motor is carried to another room and there set on the table to drive the sewing machine. Upon the conclusion of its day's labors it is packed away in a small box and stowed in the cupboard.

As may be imagined the Electric Mary Ann has innumerable advantages over its human namesake. It is hard-working, clean, quick and reliable. There is never complaint of the arduousness or protracted nature of the task in hand; it never grows tired; is always ready and willing; and has no wasteful habits. No rests or holidays are required.

CUTTING THE INVISIBLE

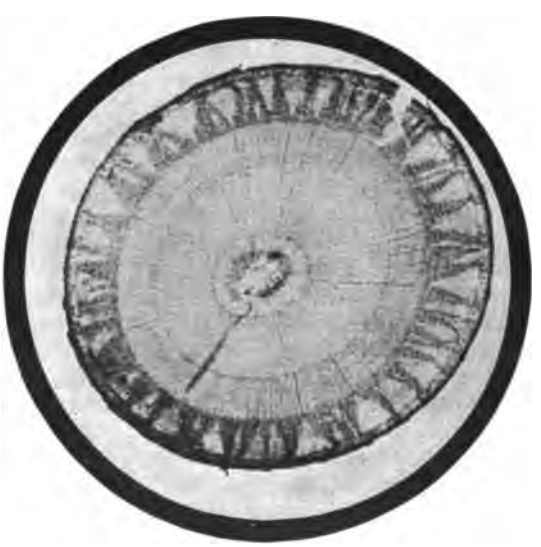
By

C. H. CLAUDY

AN instrument is being made which cuts sections so small, so fine, from materials to be examined under microscope, that, to be Irish, were it possible to look only at the edge of one, it would be quite invisible!

Few people, beside those whose use of the microscope is a matter of daily habit, know that its power is so great that in certain cases, what it delineates must be so small as to be almost if not quite invisible to the naked eye, otherwise it would make the object too big for the microscope eye to see; yet, when one uses an instrument which magnifies the apparent proportions, let us say two thousand diameters, or four million times, it is obvious that the object itself must be pretty small if its image is not to fill all available space!

In the case of objects which come not in battalions, but in single spies, this is all very well. We can isolate a diatom or two or a few bacteria with comparative ease. But when our object is part of another object —or when it is one of countless millions, getting it off into a corner by itself for examination is not so easy. Even the microscopist is puzzled when it comes to picking up and turning over an individual blood corpuscle— and how much more difficult must it be to get hold of some particular cell in the body—stain it and manipulate it that the microscope may see it.



A SEGMENT—GREATLY MAGNIFIED—OF THE VEIN OF A LILY.

THE MICROTOME CUTTING SERIAL SECTIONS ONE MICRON THICK.

Hence, the microtome, an instrument which cuts shavings from material presented to its knife edge, so fine, so attenuated, so inconceivably thin that you might pile a hundred together and still not have the pile thick enough to see, if you looked at the edge!

He has keen eyesight who can distinguish the lines in the halftones which make the illustrations in this magazine. Yet they are only 130 to the inch. No eye is keen enough to separate the lines of a half-tone running 400 to the inch. But suppose the lines ran a thousand to the inch—two thousand—ten thousand —twenty-five thousand!

One micron—one one-thousandth part of the one one-thousandth part of a meter—the one twenty-five thousandth part of an inch—is the thickness of the finest slice which the modern microtome can cut, and does cut, for certain explorations into the ultimate composition of flesh and tissue of all kinds.

This is the way it is done.

The tissue to be sectioned—to use the proper term—is first prepared for the work by being, in some cases, infiltrated with paraffine—that is, it is so treated that it is not only imbedded in this medium, but permeated by it—so that paraffine is everywhere within it and throughout—as air permeates a sponge, or the ether permeates matter.

This little block of paraffine, with the molecules of wax jammed in between and all about the molecules of the substance itself is then clamped in position in the microtome. Of course, these instruments are made in many ways, but in this particular instrument, which does such remarkably fine cutting, the prepared block is fastened to a clamp which moves upward on a machine screw. This machine screw has a pitch of one-half of one millimeter. When the screw makes one complete revolution, the clamp has traveled upwards the two thousandth part of a meter. A meter is thirty-nine and a fraction inches.

At the bottom of the screw is a wheel, and on the edge of the wheel are five hundred teeth. Working in these teeth is a pawl, which by a crank, gear and slide action, pulls the wheel by means of its teeth. If the wheel is revolved one five-hundredth of its circumference, or if, in other words, but one tooth is skipped by the pawl when getting ready to pull, the clamp has advanced upwards one five-hundredth part of one-half of one millimeter—one one-thousandth of one millimeter in other words, which is one micron.

At the top of the instrument is a knife. Not an ordinary knife, by any means, but a wedge of steel which is the pick of dozens of candidates. It is flawless as to temper, flawless as to edge, and the bottom of its edge is a true straight line. Sharpening a microtome knife is to sharpening a razor, as sharpening a razor is to sharpening a scythe, in point of accuracy, fineness and difficulty!

How a Section of the Eye of a Fly Appears.

The clamp, in addition to its movement upwards along the screw, moves back and forth, back and forth, to the slow beats of the hand moved mechanism, and every time it moves back the pawl makes a little hitching stroke on the teeth of the wheel, the clamp moves upward and presents a fresh piece of material to the knife blade, and every time the clamp moves forward again, a new section is made from the paraffined object and rests, a gossamer thin wisp, upon the top of the blade.

Now a mechanic will tell you that there is, in all this, no special difficulty —that almost any good man at a lathe and milling machine could cut five hundred teeth in a wheel, and threads of half a millimeter pitch in a screw. "Of course," he will say, "working as fine as that there are apt to be inaccuracies at times. Some of the sections such a machine will make will be thicker than others, but these can be discarded."

And just here is the difference between the mechanic who makes watches and he who makes microtomes.

A good microtome has to be perfect all around. It must cut not one, nor twenty nor a hundred, but any number of sections, one after the other, all alike, all the same thickness, all perfect. One of the great advantages of the microtome is the ability it gives the pathologist and the entomologist to study the same thing from a large number of different points of view. For instance, there is in existence a set of sections of a mosquito—a hundred or more slices of his body, arranged in series, and there are no sections missing. These sections were made with a microtome. If the microtome missed one section, the whole series was spoiled, since what was wanted was a complete set. As it was, there was trial and error and trial and error again, before exactly the right insect, received exactly the right infiltration treatment, and was cut in exactly the right microtome, to exactly the right thickness of sections. There was almost a famine of mosquitos before this was accomplished, and it never could have been accomplished if the microtome had failed. And it is in this last word of accuracy that the microtome of today excels; it is because it is able to cut a perfect section of a known

thickness, not once but a thousand times, that it is a real mechanical marvel.

Microtomes are of many varieties. There is the freezing instrument, a simple clamp and screw, with little tables across the top of which a knife in the hand is pulled, designed to attach to a cylinder of carbon dioxide, which, spraying on the bit of flesh to be sectioned, freezes it and holds it stiff. Its purpose is to section and permit study of morbid tissue during an operation.

There are the so-called laboratory microtomes, instruments built for rough hard work where extreme fineness of cut is not essential and getting rigidity by having the knife, rather than the block, move back and forth. Then there is the rotary microtome, which moves the object and clamp up and down instead of back and forth, and finally, the precision instrument, in which the knife can be clamped at any angle and which can take the largest possible piece of tissue required, save only a brain. Brain microtomes are made, but never yet as perfectly as their smaller brothers. It is an achievement for the future on which much work is being done—the construction of a microtome big enough to section a human brain, but accurate enough to equal the smaller instrument in fineness of cut.

Unknown, little, uncomplicated, but embodying in its tiny moving parts the *ne plus ultra* of mechanical accuracy and skill, the modern microtome plays a part in the use of the microscope second only to that eye of science itself. That it is not less perfect mechanically than the microscope is optically is one of the reasons why the microscope has been able to delve so far into the mysteries of nature and at least approach the door behind which she hides her greatest secret—the structure of the spark of life.

FARM SCHOOL FOR THE CITY BOY

By

S. L. WALSH

A RED-HAIRED, freckled-faced boy, with a cast in his right eye, came running down the dusty street, white and hot beneath the rays of the afternoon sun. Behind him trailed a troop of some half-dozen other boys, ranging in years from ten to fifteen.

There was a certain tense stealthiness in their movements that betokened mischief, emphasized by the fact that the leader carried a good-sized stone in either hand.

The little band halted in front of a house set in a small, trim, well-kept lawn.

"This the place, Micky?" one of the party asked.

Micky nodded, his breath coming quick, apparently as much from excitement as from haste.

The next moment they were on the lawn, tearing up bushes, trampling upon the beds of full-blown geraniums, and then with a loud whoop, and a volley of stones, *bang, bang, bang, bang,* against the door of the house, they had swept away like a band of Iroquois, out for plunder.

From within the dwelling, an old man, much agitated, hastily appeared.

"Oh, Mr. Horchem," he called out eagerly, to a passerby, "which way did those imps go? If ever I catch that pest, Micky Callahan, I'll wring his neck! I didn't see him at it, but I know he's at the bottom of this."

And that is how Benjamin J. Horchem, principal of the Audubon School, at Dubuque, Iowa, first heard of Master Micky Callahan, and it was from this conversation with the old man whose flower-bed had been ruined, that a long-cherished idea of founding a

READY TO DRIVE TO MARKET.

farm-school for city boys became crystallized. The development of the farm-school and Micky Callahan's subsequent history belong together.

This ragged little Irish urchin, the old man told Mr. Horchem, had for some time past been the terror of "Dublin," as the south end of Dubuque is locally called. His mother was an invalid and his father idle and shiftless. But thirteen years of age, the boy possessed a strong influence over his youthful associates, even those older than himself. They had grown more and more daring in their deviltry, and it was only a question of time, the narrator suggested, when the lad would find his way to the reformatory.

"It isn't so bad when the rascals are in school, but in vacation time they do play the mischief. If Micky was only away they'd stop all this. I'd give fifty dollars to keep him out of the neighborhood."

As he listened to the tale of vandalism the idea so long nebulous in Mr. Horchem's mind all at once seemed to take on concrete form. "If you really mean that I'll undertake it," he said. "At least I'll guarantee that after this year the boys don't do any more damage or money refunded."

And the old man, after a moment of intense scrutiny, said he would send the money the next day, and he did.

North of the city lay a small, abandoned, partly worn-out truck farm, of some several acres, with its dilapidated dwelling and barn. This Mr. Horchem learned could be purchased for almost a song,—seven hundred and fifty dollars,—as the owner was very desirous of immediate disposal of the property.

Mr. Horchem did not have the ready money himself, but he went to a number of prominent citizens, telling them the story of Micky Callahan, and explaining his project, in part. For away beyond his immediate purpose of giving the boys something definite, healthful, and useful to interest them during the summer, a much larger project loomed. But this larger project would require more capital than he cared to solicit at this time.

The first man approached wrote a check for one hundred dollars. "If it's for boys, I'm with you," he declared heartily. "I know you have a reputation for managing boys and doing them much good."

And, indeed, Mr. Horchem is a born manager of youngsters. He seems thoroughly to understand the psychol-

BEGINNING THE WORK OF CLEARING A WEED PATCH.

ogy of the boy mind. In his school, which is in the north end of the city, remote from "Dublin," he established several years ago a debating society. Every Friday night, the boys, as many who have finished school as those still attending, assemble during the winter months, and the room is invariably crowded. He secures results partly by working on the imagination of the boys, partly by a mixture of play and fun with their more serious endeavors, partly by helping the boys to undertake things of their own accord, thus fostering their sense of pride and independence, and partly by a personal magnetism that is as incapable of analysis as it is compelling.

Nothing was done with the boys that summer, but during the fall and winter a man was hired to do some work in the way of repairing fences, spreading fertilizer, etc.

Then in the spring, Mr. Horchem got together some of the boys of his own school, and on Saturdays and after hours sallied forth to till the little plantation. As yet he did not call upon Micky and his cohorts for service.

In furtherance of the idea of partial self-government, which Mr. Horchem has found so invaluable in controlling boys, officers of their own choice were elected, these consisting of a president, manager, secretary, and treasurer.

With his organization complete, the initiator of all this made it a point to meet Micky Callahan in an apparently casual way. And almost before Micky knew it he had promised to bring his "gang" the next Saturday for a grand carry-all ride to the farm.

That day Mr. Horchem kept his "own boys" at home, not wishing to take any chances of arousing sectional antagonism. And Micky played square. He laid aside his mischievous spirit and with thirteen of his companions, actually went seriously to work.

As the little party rode homeward in the evening, Micky said impulsively, but gravely, too, "We've had a bully time today!"

So by middle summer the grounds, barn and house had been put in fairly good shape. The crops which had been planted were flourishing, the dwelling had been improved by the addition of a porch, and a suitable roadway leading up to it had been undertaken and put through.

About July a curious thing, almost incredible to the good people of "Dublin," was reported. Micky Callahan

had not only ceased molesting the neighbors' gardens but was actually cultivating a flower bed of his own!

At the close of the summer one of the boy officers made a report as to the success of the season. Extracts from it speak more to the purpose than any secondary account can do:

"Our first taste of farm life was hoeing. Some of us hardly knew how to hoe, but now we consider ourselves experts. Then we cultivated onions. Of course we cut quite a few off, but we would not do such a thing now. . . . Then came market days, when we took our produce to market. The first time the rig was driven to market it contained the general manager and treasurer. These two officers went in their wide-brimmed rustic straw hats, upon which was showered a great deal of ridicule. Their first experience at marketing was not very pleasant. . . . After that we took turns in going to market, always taking care that we did not have our straw hats on. We hired a stand at the market, and there we could be found, selling our peas, beans, carrots, cabbages, beets, and other vegetables. . . .

. . . "We did not work every day, sometimes three times a week, and sometimes only twice. In summer during the hottest part of some days we played in the shade or rehearsed our band composed of such instruments as we could get together. We had many discussions concerning our work, novels we had read, or topics concerning the welfare of the country. . . .

. . . "There were many other boys that wanted to join, but we felt that there were no accommodations for so many."

This report covers the first summer of the enterprise. The past summer a new location was secured on the bluffs just north of Dubuque, overlooking the Mississippi River. And this Mr. Horchem hopes to make the permanent site of his farm school. Tents were pitched on the side of the hills farthest from the river, as there were no permanent buildings, and the possibilities of camping out were united with the other ideas of the movement.

In the new location the beginnings of an orchard were laid out, together with such varieties of trees as the eucalyptus and soft maple. Also raspberry, blackberry and similar small fruits were planted.

Private individuals continue to subscribe to this work, and trustees of that part of the Russell Sage estate, which his wife has laid aside for educational purposes, have investigated Mr. Horchem's plans, and while making no promises of pecuniary assistance for the Dubuque project, they did encourage him by their enthusiastic praise of the new ideas they had obtained to take back to their work in the slum districts of the large cities.

So far Mr. Horchem has given his time and energy without pay. At present the project is practically a private one supported by private subscription. His ultimate plan is the union of his farm plan with the more essential features of modern educational methods, in the public schools. He would have schools in the suburbs, and have the children as much in the open air as possible. It is not his purpose to make farmers of city boys, as some of his townspeople have erroneously interpreted his work. Nor does he wish to abolish the three good old "R's," "reading, 'riting, and 'rithmetic." At the same time, however, he wishes to show the city-boy that there are other careers open to him beside the factory, the shop, or the office. He believes that by making school work natural and free thousands of just such boys as Micky Callahan can be reclaimed.

He seeks to establish an institution where he can teach his theories of farm school work. He believes that teachers throughout the whole upper Mississippi Valley would be attracted toward such an enterprise. The site is ideal, overlooking as it does the broad bosom of the Mississippi, with the view extending into the states of Wisconsin and Illinois for over twenty miles. From such an institution he believes his ideas could be disseminated as have the kindergarten idea, manual training and other similar modern movements in education.

Only a Hope

HE—"Farewell, my darling, I hope you will remain true to me."

SHE (through her tears)—"I hope so too." —*Fliegende Blaetter.*

Fiji Persiflage

"THAT missionary I ate last night," said the King of the Cannibal Islands, with a wry face, "must have been full of deleterious substances. I have been very ill ever since I ate him."

"Well, your Majesty," said the Grand Vizier, with a low salaam that his Royal Highness might not see the smile upon his face. "you know there is a saying among the people of the parchment face that you cannot keep a good man down."—*Harper's Weekly.*

Which Won?

"YES," said the determined man, "when that waiter resented the smallness of my tip I took the case to the proprietor of the restaurant."

"And what did the proprietor do?"

"He gave the waiter some money out of his own pocket and apologized to him for having such a customer."—*Washington Star.*

Unkind

SAID the bibulous gentleman who had been reading birth and death statistics: "Do you know, James, every time I breathe, a man dies?"

"Then," said James, "why don't you chew cloves?"—*The Housekeeper.*

Not the Only One

"FWHAT name?" asked the maid.

"Just say to the young lady that George is here," answered the caller.

"Yis, sor, but if she asks me 'which George is it?' fwhat'll I say, sor?"—*Chicago Tribune.*

Where it Won't Work

No, AGNES, the gyroscope will not enable you to keep your balance at the bank.—*Puck.*

No Assistance Needed

AS THE train neared the city, the colored porter approached the jovial-faced gentleman, saying, with a smile:

"Shall Ah brush yo' off, sah?"

"No," he replied; "I prefer to get off in the usual manner."—*Princeton Tiger.*

Corned

"DON' talk that away tuh me. He jest layed there on the baid an' faded away, lak, befo' muh eyes. Ah don't know why. The doctah he says as how it was thuh indigestion, but muh man he ain't et nothing 'cept kawn fritters every meal fo' a month, so it cain't be thet. No, suh. He jest *frittered* himself away, iak."—*The Circle.*

She was Needed

"WE represent the great state of Texas. The first white woman born in Texas is still living—she now has a population of over three millions."

There was a pause of bewilderment for a

moment, and then a voice from the gallery rang out clear and distinct:

"Send that woman out to Wyoming—we need her."—*Everybody's Magazine.*

Hitting it Up

A GUEST in a Cincinnati hotel was shot and killed. The negro porter who heard the shooting was a witness at the trial.

"How many shots did you hear?" asked the lawyer.

"Two shots, sah," he replied.

"How far apart were they?"

"'Bout like dis way," explained the negro, clapping his hands with an interval of about a second between them.

"Where were you when the first shot was fired?"

"Shinin' a gemman's shoe in de basement of de hotel."

"Where were you when the second shot was fired?"

"Ah was a passin' de Big Fo' depot."—*The Herald and Presbyter.*

The Measure of Art

DE FRIEND—"What is that picture intended to represent?"

DE ARTIST—"Board and lodging for six weeks."—*Milwaukee Wisconsin.*

A Rising Market

"I SAW you kiss sister last night."

"Did you, Bobby? Here's a quarter for you."

"Thanks. And then I saw you kiss the maid in the hall."

"Great Scott! Here's five dollars!"—*Life.*

Getting Even

HE—"Why not give me your reply now? It is not fair to keep me in suspense."

SHE—"But think of the time you have kept me in suspense!"—*M. A. P.*

A Call for Cough Drops

"I TELL you I must have some money!" roared the King of Maritania, who was in sore financial straits. "Somebody will have to cough up."

"Alas!" sighed the guardian of the treasury, who was formerly the Court jester, "all our coffers are empty."—*Tid-Bits.*

Did He Get It?

"Now, Mr. Janus, I don't see how with your salary you can afford to smoke such expensive cigars," remarked a merchant severely to one of his clerks.

"You're right, sir," responded Janus. "I can't; I ought to have a bigger salary!"—*Judy.*

A Neighborly Precaution

THE new clerk at the drug store returned the prescription to the old customer with a request that he wait till the boss returned.

"But why can't you fill it out?"

"I could if you was a stranger, but I ain't to fill 'em for folks that lives about here."—*Success.*

A Distant Prospect

"AND you say you love me?

"Devotedly!"

"With the cost of living as high as it is?"

"Indeed I do, and when the cost of living is less I will prove my love by making you my wife."—*Houston Post.*

And That's Going Some!

A TEACHER in a New England grammar school found the subjoined facts in a composition on Longfellow, the poet, written by a fifteen-year-old girl:

"Henry W. Longfellow was born in Portland, Maine, while his parents were traveling in Europe. He had many fast friends, among whom the fastest were Phœbe and Alice Carey."—*Everybody's Magazine.*

The Belle

SMITH'S wife had died, and Mary Jones, the bosom friend of the dead woman, had asked the afternoon off to attend the funeral.

On Mary's return from the funeral her mistress said to her with gentle sympathy,

"And did you get on all right at the funeral, Mary?"

"Indeed, ma'am, I had an elegant time," Mary answered. "I was in a fine cab with the corpse's husband, and he squeezed me hand all the way to the cemetery and back, and he said, said he, 'Mary, there's no getting round it; you're the belle of the funeral.'"—*Harper's Magazine.*

DEVICE FOR INFORMING ENGINEER OF LOCOMOTIVE WHETHER LINE IS CLEAR OR BLOCKED.

AN AUTOMATIC FOG-SIGNALLER

By F. A. TALBOT

A RETIRED Dutch naval officer, named Ruyter van Steveninck, has perfected a means of warning locomotive engineers of the state of the road in the thickest foggy weather by means of an automatic electric "fogger." It consists of a revolving wheel around the circumference of which are carried a number of cartridges. A large funnel-shaped horn is placed facing the approaching train and at the apex or mouthpiece of this horn the cartridges are fired, one at a time by the train itself.

At one end, on one side, the cartridges carry a small screw insulated by ebonite on the sides. To the inner end of this screw is attached a short piece of platinum wire forming a loop, its other end being connected to a metallic cap by means of which the screw is held in the cartridge, and insulated therefrom by the strip of ebonite. This loop of platinum is surrounded by gun cotton and the cartridge itself is charged with common black powder. The wheel in its revolution can only advance the distance of a cartridge at a time, being checked by a metallic spring buffer which, when the magazine is in the firing position, presses against the metallic cap of the cartridge. From these two contacts wires are stretched communicating with each of the respective rails and a battery. A length of rail is insulated and it will be seen that the electrical circuit is only broken by the distance between the two rails of the track. Consequently when danger threatens and the engine enters upon this insulated section the circuit is completed through the locomotive itself, and the cartridge fired, producing a loud report which is thrown through the trumpet towards the locomotive.

POPULAR · SCIENCE
& MECHANICS
SUPPLEMENT ·

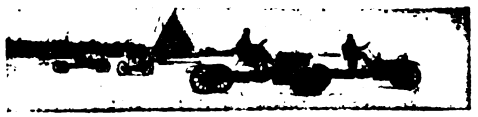
MAN OF TWO HUNDRED THOUSAND YEARS AGO

EFFIGY OF FIRST MAN.
Yale scientist's reconstruction of the father of the race.

AN ingenious reconstruction of man as he appeared in the Paleolithic Age, as made by scientists at Yale, is of great interest on account of the variation from present day mankind. This man of ancient times was variously known to science as Homoprimigenius, neanderthalensis, or monsteriensis. He was a man of low stature, standing only five feet three inches in height, but of great strength. In all probability the men of that day were much more hairy than the model would indicate, as they had little or no clothing and the climate was severe. This type dwelt in Europe before the last glacial period, estimated at from 100,000 to 200,000 years ago.

His close resemblance to the higher forms of apes is shown in the great length of his arms as well as in his features. His weapons were probably either rude axes of stone or, more frequently, the bones of some animal, such as the jawbone carried by the specimen shown in the illustration. With such weapons as this he went forth to make a kill for his meal or to defend his cave home against the giant dinosaur, or the monster flying lizard of his time. He was as ugly a brute as his enemy.

A REMARKABLE STUDY.
How our first progenitor probably appeared in full dress.



TESTING MOTORS ON ICE.
How Lake St. Clair is turned into a race-course, near Detroit.

TESTING MOTOR ON ICE

THE accompanying illustration shows a group of motor car testers and their strenuous methods of negotiating the "automobile waltz" on the smooth ice of Lake St. Clair, near Detroit, Michigan. The marks on the ice indicating how the machines spin in perfect circles, the ice yachts noted in the background racing at times in the speed test with the motor cars.

In the early days the purchaser of an automobile trusted to good luck to get along with it without trouble. Modern ways are different and the well conducted automobile company now undertakes to see that the cars give the service expected of them.

RAPID PILE DRIVER.
Pneumatic tool that drives heavy timbers with great dispatch.

RAPID PILE DRIVER

THE New York, New Haven and Hartford Railroad in the lengthening of its electrified mileage has discovered a new application of steam and compressed air in the driving of piles to form foundations on which electric transmission towers are erected. Formerly a cumbersome pile driver of the ordinary type was used and besides giving very unsatisfactory service it took a great length of time to drive piles.

The railroad has now adopted the steam or compressed air pile driver shown. It requires no lifting and dropping and works very much on the same plan as an ordinary riveting hammer of the pneumatic type usually seen where bridge builders are at work. This hammer gives a great number of strokes per minute and thus makes up in speed what the old type of pile driver might have in the greater force of the blow delivered at each stroke. The speed is due in a large measure to the fact that one blow is followed up with another before the ground has had a chance to settle back around the pile. It was found that this method results in the driving of a pile every minute and sixteen seconds. With the old method it required slightly over three minutes.

CONCRETE HORSE TANK

CONCRETE is rapidly coming into extended use on the farm as a building material. This is particularly true for such structures as silos and horse tanks. The illustration shows the concrete tank used for the record pacer, Dan Patch.

CONCRETE HORSE TANK.
Excellent form for use of the material for this new purpose.

NEW TYPE OF REINFORCED CONCRETE BRIDGE

THE wonderful possibilities of the use of reinforced concrete in bridge construction are demonstrated in the new bridge that has been built across the Colorado River at Austin, Texas. The distinctive feature of this bridge is the extraordinarily long spans, each being 115 feet with an 18-foot rise. Notwithstanding the unusual length of the spans the lines of great strength are maintained and none of the artistic appearance of the structure is lost. The arch ribs are 32 feet wide and support fifteen reinforced vertical members, which, united by arches, carry the floor system. The width of the floor is 50 feet, of which 38 feet is taken up by roadway and the remainder by sidewalks. Cantilever arms extend nine feet on each side, forming the sidewalks and part of the roadway. The ornamental handrails are also of concrete.

ODD FORM OF CONCRETE STRUCTURE.
Arched bridge across the Colorado river at Austin, Texas.

SPARK OF 500,000 VOLTS.
Remarkable photograph of electric display.

A SPARK AT HALF A MILLION VOLTS

THE illustration shows a testing transformer built in Germany. It develops the enormous pressure of 500,000 volts across its terminals.

In the picture two small wires are connected to the terminals and their ends pointed toward each other. This causes an electric discharge to leap from one to the other with a brilliant flash three and a half feet long, and with a sound that is almost deafening. It is a startling phenomenon.

AUTOMATIC PACKAGE TIER

ONE of the great problems that has always confronted the post office department has been the rapid and economical tying of its mail in bundles before placing in the pouches in which it is carried from town to town.

This operation has always been carried on by hand and, while Uncle Sam's clerks become very expert, the work at best is slow and tedious.

The machine shown in the illustration is arranged to tie packages of varying thicknesses in about one-half the time required by the old method. It is now being given careful trials by the United States government in some of its offices with a view to adopting the system.

AUTOMATIC PACKAGE TIER.
Curious machine that fastens parcels of mail together.

INTERLOCKED MOOSE ANTLERS

AN extraordinary reminder of a fatal battle is shown in the accompanying illustration. This rare and unique trophy is a pair of interlocked moose antlers, the result of a deadly encounter between two giant bull moose in the wilds of the Kenai Peninsula, Alaska, a year or so ago. This specimen is soon to be exhibited in the great collection of heads and horns now being brought together at the New York Zoological Park, which comprises some of the largest game heads of America and elsewhere. During their duel the powerful and enraged moose used their broadly palmated antlers as weapons of offense and defense in a series of tremendous charges and assaults which they made upon each other. In the course of the fierce encounter the antlers became so firmly entangled and locked that neither of the combatants could break away. A native hunter heard the loud clashing of the horns a half a mile or so in the forest and started for the scene of the conflict. At a distance, spellbound, he witnessed the marvelous battle of the two giants battering and crashing into one another with the energy of two locomotives in a head-on collision. On nearing the two antagonists, he found that one of the animals had broken its neck during the struggle and lay dead on the ground, while the other, partly exhausted, was making herculean efforts to release his horns. The hunter then killed the living moose, and reported the duel to a nearby trading post, and the two heads were secured and fortunately preserved. The animals were of gigantic size, probably ten or twelve years old, the larger pair of horns having a spread of sixty-nine and one-half inches, and the other sixty-two inches.

INTERLOCKED ANTLERS.
Reminder of a fatal battle.

The antlers are so thoroughly interlocked that no human hands can separate them. Naturalists report that the occurrence is not uncommon and other horns locked together in similar fashion have been found at various times and places. Locked stags' antlers are preserved in certain museums.

CURIOUS NEW BRITISH SUBMARINE.
Boat of the C class that has hydroplanes at the bows. Planes may be seen through the spray at the bows.

NOVEL AMUSEMENT DEVICE.
Curious gun, supposed to shoot passengers to the stars.

TRIP TO THE PLANETS

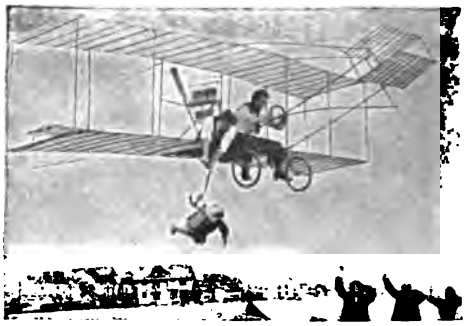
AN amusement device which, while being perfectly harmless, would nevertheless afford all of the sensations of a trip to Mars, the moon, and to any of the planets, will appear at many amusement parks this summer. It is a thriller which will make the visitors to it undergo all of the sensations of a flight through the air after having been shot out of a large cannon. The passengers are seated in a projectile which is rolled on wheels into the breech of the gun, which stands twenty-four feet high and has a length of one hundred and eighteen feet. All is darkness for them. There is an explosion and the projectile is submitted to a rocking motion, while at the sides clouds seem to flit past. In the muzzle of the gun, a moving picture machine is mounted and upon a screen this throws the scenes of Mars, or the other country visited, while electrical effects add to the realistic features of the deception or illusion. Contracts have been made for the installation of guns at Redondo, Denver, San Francisco, Salt Lake, Buffalo, New York, Chicago and St. Louis.

TREASURY OF PHARAOH.
One of the wonderful rock-hewn temples of Petra.

THE TREASURY OF PHARAOH

THIS is in some respects the most remarkable of the rock-hewn temples and tombs of Petra, the rock-hewn capital of Edom, and later of the Nabataeans, whose king, Aretas, mentioned in the Bible, extended his conquests as far as Damascus. This monument of antiquity is thought to be the work of the Romans, being attributed by some to the Emperor Hadrian, who visited the palace in A. D. 131. The color of the sandstone rock from which this vast monolith was cut is a delicate rose pink. The imposing facade shows two rows each of six majestic columns.

A VALUABLE COW.
Three-year-old Holstein that averaged eighty pounds of milk per day, for seven days.



FAKERY OF PHOTOGRAPHY.
Posed picture that might very easily startle the uninitiated.

RECORD-MAKING COW

"HANDSOME is as handsome does," is an adage which could as well be applied to the domestic animal as to the human race. The little animal shown in the illustration is certainly doing her part to make her material worth compare favorably with her handsome appearance.

She is a registered Holstein cow, three years old, and is owned by Mr. E. La Munion of Solsville, N. Y. In a test recently conducted by the State Agricultural Department, the cow averaged over eighty pounds of milk per day for seven days, and from this was made twenty-nine pounds of butter.

A PILE OF THE BRONZE AGE

THE photograph represents the point of a pile remarkably well preserved, as it dates from the Age of Bronze, 2000 B. C.

This point was found near Lake Leman, Switzerland, and is supposed to have formed a part of the palafitte of Bairon.

These were lake dwellings or huts of prehistoric times, constructed on piles over a lake or other body of water, and characterized, in occidental Europe, the last phase of the Stone Age.

The wood of this pile is of oak; one can recognize distinctly the blows of the hatchet which served to shape it, and which are as clearly defined as if the work of the carpenter had been done yesterday. The shape is quite as good for its purpose as more modern pile-points.

PILE FROM THE BRONZE AGE.

FAKEOGRAPHS

"FAKEOGRAPH" is a newly-coined word to fit the needs of one branch of photography, and the accompanying picture gives a clear idea of all that the word implies. A good fake needs no apology, in fact the artist is rather proud of the results obtained by printing several negatives on one card and producing startling combinations.

The airship shown is in reality on terra firma, from which it never departed. Nor was it intended to, as it is built of gas pipe and heavy canvas and equipped with a dummy engine. In the negative, the scaffolding on which the biplane rests was carefully painted out and two other negatives were used in connection with the first, one of them representing the victim in mid-air, the other an ordinary snap-shot of the landscape with figures.

In order to be at all convincing the "fakeograph" should have little brush work, or if possible, none at all and in the specimen herewith only the rope and anchor have been drawn. The effect is quite startling, however, and it reveals how easily the eye may be deceived by such fakery.

CONCRETE LIGHT POLES.
Handsome new improvement recently placed in a Chicago street.

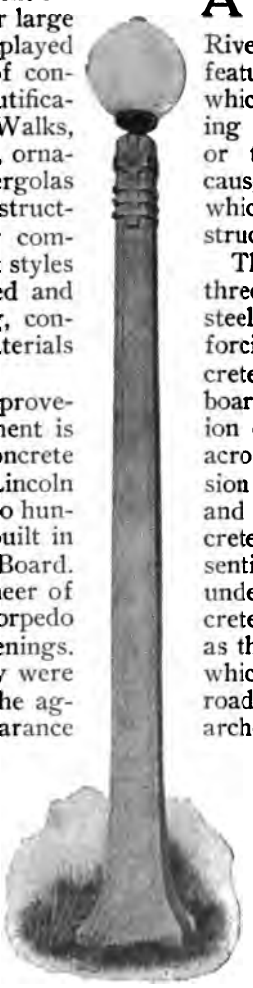
JOINTED BRIDGE OF CONCRETE.
Novel form of construction to allow for expansion and contraction.

CONCRETE IN THE "CITY BEAUTIFUL"

THE "city beautiful" movement inaugurated in several of our large cities in recent years has displayed in a striking way the value of concrete as an agent for the beautification of boulevards and parks. Walks, fountains, benches, lamp posts, ornamental fences, pavilions, pergolas and buildings of all kinds constructed of concrete are becoming common. With the many different styles of finish which can be secured and the artistic effects in coloring, concrete surpasses all other materials for this class of work.

An example of boulevard improvement which has excited comment is found in the reinforced concrete electric light standards along Lincoln Park Boulevard, Chicago. Two hundred and fifty of these were built in the shops of the Lincoln Park Board. They were finished with a veneer of white cement mixed with torpedo sand and red granite screenings. After the cement was set, they were brushed with acid to expose the aggregate, giving them an appearance resembling cut granite.

Another rather unusual application of concrete in park improvement is the park bench, of which there are a number along the Lake Shore Drive, Chicago. Concrete is so generally used now that articles of all sorts are appearing in the material.



THIS IS THE POLE ITSELF.

JOINTED CONCRETE BRIDGE

A BRIDGE is now nearing completion across the Los Angeles River which is unique in several features, the most interesting of which is the system of joints, allowing for the settling of the concrete or the expansion and contraction caused by variations of temperature, which might otherwise injure the structure.

This is accomplished by means of three hinges, cast iron, bolted to steel beams, around which the reinforcing rods are looped, and the concrete is divided by pouring around a board covered with felt. This division of the concrete is carried clear across the bridge, so that any expansion will be taken up by the wood and felt, and will not crack the concrete. The arches, instead of presenting a smooth surface on the under side, as in the ordinary concrete bridge, are of what is known as the "rib and slab" construction, in which the sidewalks, car tracks and roadways are borne by separate arches, although the slab supporting the traffic surface is continuous, allowing the same finish as an ordinary paved street. The roadway of the bridge will be 56 feet wide, with two car tracks in the center and a sidewalk five feet nine inches on each side.

The detail photograph shows the joint and also the rib and slab construction.

AIRSHIP OF THE DESERT.
Carriage for camel back that supports a hammock.

AIRSHIP OF THE DESERT

APROPOS to the expression "Ship of the Desert" as applied to the camel, and to the popular interest in aeroplanes, is this photograph of an aeroplane-looking structure carried by a camel which supports a kind of hammock in which two or three Bedouin women and children ride. The sight of one, except among the far interior tribes of Bedouins, is unusual. This photograph was taken on the uplands east of the Jordan. It has a decided resemblance to some types of flying machines.

POLAR BEARS' NATURAL HOME

WHAT is declared to be the first artificial bear den is in Mr. Carl Hagenbeck's park, in Berlin. In design it represents the polar regions and the bears appear to spend their time clambering about over huge cement blocks made to resemble pieces of ice. The animals being confined to their allotted quarters by a concealed ditch, the effect is very natural.

ANCIENT HORSESHOES

AS a protector for the tender hoofs of horses, the Egyptians and other ancient races used wickerwork, felt, or leather shoes, such as are still in use by the Japanese.

The old Romans were the first to employ iron soles extensively. In the beginning

NEW HYDROPLANE.
English inventor's recent idea for speed-maker.

NATURAL HOME FOR POLAR BEARS.
Hagenbeck's newest idea for making captives happy.

these were very primitive and bound to the foot, but later on the edges of the horseshoes were turned over along the sides, clamping it to the hoof.

FRENCH SWIMMING MACHINE

A FRENCHMAN, one Monsieur Garnier, has just constructed a swimming machine of a new type, as shown in the illustrations.

ANCIENT HORSESHOE.
Iron shoe used by Romans for chariot horses.

This is a sort of submarine, supported in the water by two cylindrical floats connected by a metal tube of about three inches in diameter upon which the swimmer lies on his stomach. He places his bare feet in two stirrups, and pedals as on a bicycle. The pedals are geared to a shaft in the rear section of the tube and this shaft rotates a three-bladed propeller. The ratio of the gears is such that the propellers make a number of revolutions for each revolution of the pedals, just as a shaft-driven bicycle is "geared up."

The user is not dependent upon the strength of his legs alone for speed. The swimmer can use his hands to help propel the machine and steer by turning the front float.

WHERE 290 PEOPLE PERISHED.
Burnt out dance hall at Oekocrito, Hungary, where many merrymakers lost their lives.

FRENCH MACHINE FOR LONG DISTANCE SWIMMING.

MACHINE OUT OF WATER.
Device for aiding swimmers, shown in detail.

DRYING SEA VEGETABLES.
Japanese gaining new foods from salt water.

FUEL FROM REFUSE.
Lamp black dug from waste pool of a gas works.

CULTIVATING SEA VEGETABLES

THE Japanese, who turn every possible thing to useful account, cultivate the gardens of the sea, thus obtaining a number of marine vegetables which are unknown to us. The annual crop of such vegetables which they gather is worth about $1,000,000. In some places, where the water is shallow and brackish, bushes are planted in rows, and in winter marine plants of a species called Porphyra gather upon them, to be subsequently picked off and dried on reed mats in the sun. The accompanying photograph shows the drying process. But this is only one of many ocean vegetables grown by the Japanese, who not only eat them fresh, but put them up in appetizing forms for use as preserved products.

CHAIR MADE FROM BONES OF WHALE

PROBABLY the most remarkable chair in existence is that constructed from the vertebrae and ribs of a whale. This unique piece of furniture was built by a marine painter named Emerson, who lives on Terminal Island, California. On the southern beaches these huge bones are not infrequently cast ashore and are often put to more or less decorative purposes.

A BONE CHAIR.
Memento of a whale that has a use.

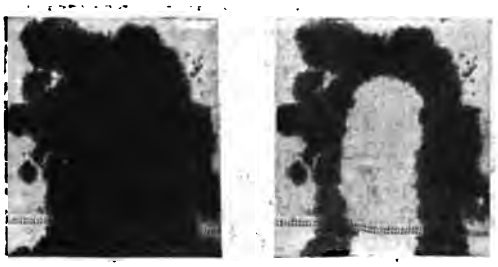
It will be noted that the concave surface of the vertebra is naturally fitted for the seat of an easy chair, while the gracefully curving ribs lend themselves to a pleasing design for the arms. A foot rest is attached to the base of the chair and is made from a section of rib.

FUEL FROM REFUSE

THE overflow from a western gas works was allowed to drain into a vacant lot where it formed an unsightly black puddle of no value to anyone, until a thrifty resident of that neighborhood conceived the idea of turning an eyesore into dollars. He diverted the flow from the gas works in such a way that part of the pond was allowed to evaporate while the other half was being filled, and from the bottom of the dry pool dug out several tons of lamp black. This is almost pure carbon and when sufficiently dried forms an excellent fuel which is readily salable for domestic purposes if pressed into convenient sizes.

The photograph shows the chunks of lamp-black set out to dry in the sun, while the press used in making them can also be seen. This is an example of the thrift that turns waste into by-products and is another method of saving our national resources.

THE GIANT CRAB.
Photograph taken under water by submerged camera.



STAIN TREATED BY ELECTRICITY.
Eradication, by use of current, the newest method.

MODELS OF HUMAN TEETH.
Large scale facsimiles made for purposes of study.

ELECTRICITY REMOVES STAINS

AN exceedingly useful article just invented is the new portable electrolytic local bleaching apparatus which enables us in our own homes to remove within two or three minutes any accidental stains from articles such as table cloths, lace, embroidery work, etc. Tea, coffee, wine, fruit, ink of any color, may all be effectively and inexpensively removed within a few minutes, and above all the electrolytic method does not destroy the fabric of the article treated upon.

The great advantage of the new invention is obvious when it is remembered that to remove a stain in the ordinary way, one has to immerse the whole article in a bleaching solution, the action of which is very slow, taking hours and even days, and which invariably attacks the fabric and partially destroys it.

MODELS OF HUMAN TEETH

THESE are large-scale models of human teeth, designed to show their structure. The first is a molar, or "back tooth." The second is an incisor (one of the front teeth), and the third is another molar. The two latter are shown in section, so as to exhibit the outer enamel, the "dentine" (which forms the body of the tooth), and the inner "pulp," which is the living part.

ELECTRIC STAIN REMOVER APPARATUS FOR TAKING OUT DISCOLORATIONS.

The enamel is just about the hardest substance in nature. Hence it serves as a most efficient protection against decay. But, though so hard, it may be broken, and acids under favoring circumstances may disorganize its structure, thus making a break in the surface covering of the tooth—an opening eagerly seized by bacteria, which thereupon attack the dentine, causing decay and producing what is called a "cavity." If the decay goes far enough (as most people know from sad experience), toothache results.

FUNNIEST OF FISHES

THIS is the "swellfish"—familiar enough to anglers in our southern waters because of a habit of getting on the hook when it is not wanted. Fortunately for itself, it is not good to eat.

When caught, it instantly proceeds to blow itself up, converting itself into a balloon by swallowing air in gulps. If one sticks a pin into it, it collapses. No cruelty is involved in such a performance, because the air is contained between the body of the fish proper and an outer canvas-like coat. Naturalists say that this fish, when pursued by an enemy, rises to the top of the sea, hastily transforms itself into a balloon by swallowing air, and is blown by the breeze along the surface, thus having a good chance to effect its escape from danger.

A FUNNY FISH. HE BLOWS HIMSELF UP WITH AIR WHEN CAUGHT.

"LIVING TOWER"

STANDING on a little hill some 200 feet above the surrounding country, at Camp Meeker, in Sonoma County, Cal., is what is known far and wide as "The Living Tower." Camp Meeker is one of the leading summer resorts in that part of the country.

It is a real tower, but is living—in a vegetable sense—for, it largely consists of trees, of which there are four, and these are living and growing, as may be seen in the accompanying photograph.

On the top of a hill not far from this hotel were found four young redwood trees each about 150 feet in height. At the distance of 100 feet from the ground, the tops were lopped off, and at regular intervals six "stories" were built.

The floors are about 12 feet square, each resting on strong pieces of timbers, the ends of which are very securely fastened to the trees. Leading up from the different floors, or points of lookout, are regular steps, or stairways, so that one can easily go from the ground to the very top of this queer sort of "tower." On the outside of each story are high railings to prevent any one from falling from the dizzy heights.

The "Living Tower" may be seen for leagues around, while the view that may be obtained from the top, with the aid of strong field glasses, is a magnificent one.

SKELETON OF A BAT.
Note the long "fingers" of the "hands."

THE LIVING TOWER.
Garlanded tower that is feature of a California resort.

FAKE MOON PICTURE.
Photo of a tennis ball lighted on one side only.

PHOTOGRAPHING THE MOON

TAKING photographs of the moon has always been attended by more or less difficulty, owing to the length of exposure required and the fact that the moon moves a considerable distance during the period that the camera is open.

The accompanying photograph shows a very perfect likeness of fair Luna floating through a cloudless sky, but this is easily accomplished. In a dark room a lawn tennis ball is suspended against a black screen and photographed by burning a small quantity of flash powder at one side and a little below the ball.

For the benefit of those who might wish to make this experiment, the writer suggests that a piece of black velvet placed over heavy cardboard be used as the background and the ball attached by pressing a thumb tack through the background into the ball to hold it in place.

HOW BATS USE THEIR HANDS

THE skeleton of a bat is remarkably like that of a man, save in one conspicuous point. Its hands are developed on a gigantic scale, being used to form the framework of the wings, just as an umbrella is held in shape by its ribs.

One may see by a glance at the accompanying picture that the bat's great hand is provided with a thumb, which is well developed. Anatomically it corresponds quite perfectly to the hand of a human being, though specialized for so different an employment.

GERMAN GARBAGE SYSTEM.
Sorting refuse in Charlottenburg by so called Tripartite plan.

GERMAN GARBAGE SYSTEM

IN Charlottenburg, Germany, residents are required to sort their garbage. All real estate owners must provide three distinct receptacles for the garbage; one for the ashes and sweepings, one for the kitchen waste, and one for commercial rubbish, such as paper, etc. This is called the "Tripartite System," and so far is proving a great success.

The dividing of the garbage in this manner has been ordered by the magistrate, and residents failing to comply with the regulation are liable to fine or imprisonment. A large building is being constructed on the outskirts of the city for the disposal of the garbage.

STOPPING A LEAK
Part of the training of English sailors with new device

STOPPING UP A LEAK

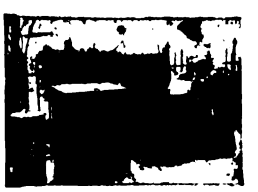
LEAKS in the body of a ship are naturally very dangerous, and various means for remedying such damages have been thought of, the most successful of which probably is a device invented by the French Admiral Pallu de la Barriere, which has been improved upon by the famous inventor Colome.

The device consists of a brass rod, to the one end of which a strong forged-iron plate is attached by means of a hinge, in such a manner that it can stand parallel or in a right angle to the rod. The latter is pushed through the leak with the iron plate first and parallel to it, and is then turned halfways, bringing the plate in a right angle to the rod. The strong pressure of the inflowing water will press the iron tightly against the outside of the ship, right over the hole, thus stopping the influx to such an extent that the further work is comparatively easy.

A cellulose stopper is next pushed over the rod, into the hole, and over that a strong steel washer which is screwed down tightly by means of a nut, the rod being threaded. As the cellulose is soft and will expand when it becomes moist, even the smallest cracks of the leak will thus be stopped up.

The simplicity of the device allows remarkably quick work. A leak of seven and one-half inches in diameter, for instance, can be closed up absolutely tight in thirty-five seconds, while if the leak is long and narrow, several stoppers have to be screwed right next to each other, which naturally takes much longer. Of course, the Colome Stoppers can be used only for comparatively small damages, and are manufactured only in sizes of six, nine and thirteen inches in diameter, a set of these being packed in a small case. Our picture shows English sailors drilling to stop up leaks. A large water tank has a hole which is opened by a lever and is to be closed by the man as quickly as possible. The sailor has to be very skillful, as otherwise the power of the outflowing mass of water would throw him down.

It is believed that the use of this device will in many cases prevent the awful loss of life occasioned by leaks in a vessel at sea and assist in making the sea less dangerous.



GARBAGE DIVISION.
German city requires separation of refuse.

A STRAW HOUSE.
Novel idea in garden decoration.

STRAW HOUSE

A NOVEL idea in garden decoration is shown in the picture of a summer house built of straw. It stands on the grounds of a southern California resort, whose proprietor found himself in possession of a great quantity of straw wrappings from bottles sold in his restaurant. Instead of burning these empty sheaths, he proceeded to utilize them by building a light circular frame of lattice work on which the wrappings were tacked, and he thus added a delightful little bower to his establishment.

A round table which will seat eight people is set inside the house and as a symbol of good cheer a large number of the graceful Chianti flasks are hung overhead, completely covering the ceiling.

GIANT'S SKULL

THIS skull has all the appearance of a real one, but is made of papier maché —exaggerated for purposes of anatomical study.

The skull is in the possession of the Army Medical Museum at Washington, where this photograph was taken. A man big enough to have a cranium of this size would be about one hundred and fifty feet tall.

GIGANTIC SKULL.
It was made of papier maché, however, and did not grow.

NEW CONCRETE PILE

A NEW concrete pile of peculiar shape has a pear-shaped base or "foot" larger in diameter than the rest of the pile. It is claimed that it presents many times more bearing area than would the bottom of a straight pile.

NEW CONCRETE PILE.
Pear-shaped foot for better bearing.

MARKET FOR ANTIQUES.
Paris shop that handles many curious.

MARKET FOR OLD BOOKS

IN the very heart of Brussels is the Palais du Midi, a large market hall in which is sold only old books and pictures and other antiquities. These are all sold in separate stalls, and lovers of old books and curios find here an almost inexhaustible mine of rare treasures.

SANTIAGO SURRENDER TREE

THE ceiba tree is one of the striking objects of the Cuban landscape. Often the branches spread out to the extent that one tree looks like a small forest in itself, or, as a Cuban writer poetically expresses it, "like a green island floating in the air."

The ceiba tree of the picture, however, is a young tree, and is not remarkable for its size. Its attraction lies in its historic significance, for it is the tree under which General Toral, the commander of the army of Spain in Cuba, surrendered to General William Shafter, commanding the American forces, July 17, 1898, just twenty-five days after the landing of our army in cuba.

HISTORIC TREE.
Place where Spaniards surrendered to Gen. Shafter.

The surrender followed the brilliant victories of El Caney and San Juan Hill. The two generals met under the tree midway of the Spanish and American lines. In the distance lay Santiago and the glistening waters of the land-locked harbor, wherein Cervera's fleet had remained bottled up for so long a time.

Every effort is now made to protect the Surrender Tree, as it is known, though the Cubans themselves refer to it as the "Peace Tree." A barbed wire fence surrounded it when this picture was taken, and it was kept under close surveillance so that it might not suffer from the depredations of vandals. Tablets, placed on posts near by, tell of the conspicuous part this tree has played in our history, while the well-beaten path leading to it testifies to the appreciation in which it is held by American visitors to the Island.

ANTIQUE SHOP DIVIDED INTO STALLS.
All kinds of antiques are sold here in small separated departments.

A FLOATING EXPOSITION

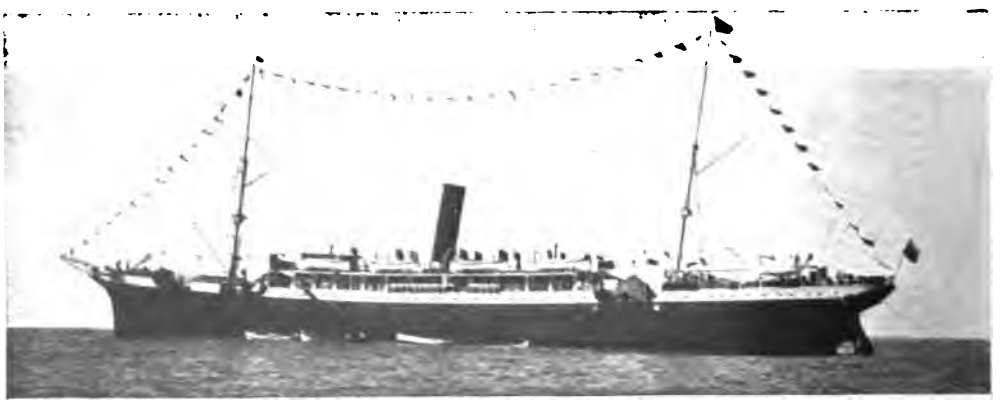
THE Russian Exposition ship, *Emperor Nicholas II,* of the Russian Steam Navigation Company, is making a very successful trip of the cities of the East, exhibiting at the various ports of call an attractive display of Russian products. This novel exposition was opened by the Czar at Yaeta. The vessel then commenced her tour from Odessa. At the time of writing she has visited some thirty ports, stopping at each place from one to twelve days. At Constantinople 25,000 persons visited the exposition in one day.

A FINE PAIR OF GIRAFFES.
These animals came from Nubia to the New York Zoo, and are worth $5.000.

Two decks of the ship are given over to the display of goods. In all, about 150 firms are represented. The largest exhibits are of cloth goods. There is also a fine display of silk goods, Russian tea utensils, compressed tea in cakes, woods, lumber and minerals. Perhaps the most novel exhibit is a miniature coal mine. There is also a large display of rubber goods. One St. Petersburg exhibitor of the latter class is said to have an output of fifty million pairs of rubber shoes a year.

THE SEED SCATTERER

ALL those who raise flowers in their gardens or indoors, will welcome a new and practical German device which makes it easy to scatter seeds evenly. It is made of a transparent material so that one can watch the outflux of the seed into the four scattering rills. Thus even the tiniest seeds can be sown thinly and evenly. The seed scatterer has had a very rapid sale during the short time it has been on the market.



FLOATING EXPOSITION.
Russian vessel that is making tour of eastern ports.

AN ELECTRIC BOOTBLACK

THE invention shown in the illustration has the unique distinction of being the first coin-operated necessity that has been placed upon the market.

One cent's worth of electricity given to this machine will both clean and polish your shoes. The machine does not apply polish but the condition of your shoe is improved by receiving a brisk rubbing and cleaning.

The electric bootblack operates upon the automatic coin principle. The shoe is placed as shown in the illustration and the deposit of coin in the slot provided starts the machine.

When one shoe has received sufficient polishing by the machine, a bell rings, and this is the signal to insert the other shoe. The work continues until the shoe receives the exact amount of energy given to its mate, when the automatic shiner ceases. If the shine is not satisfactory, deposit another penny and get another shine.

A flange brush cleans the left side of the shoe, and also the right side, but the tops are polished by a buffer contrivance.

ELECTRIC SHOE BLACK.
Gives you a quick shine for a penny.

WORLD'S GREATEST POTTERY

SITUATED on the east bank of the Ohio River, just opposite the world renowned ceramic city of East Liverpool, Ohio, stands the largest pottery in the world.

The average number of people employed is one thousand and the daily production, consisting of dinner and toilet ware is one hundred and forty thousand pieces. The plant shown in the illustration was completed in 1903, and as a result a village of considerable size has grown up about it.

The owners have improved a very large tract of land running back through the Virginia hills.

THE WORLD'S GREATEST POTTERY.
Remarkable building where a thousand people make clay vessels.

AUTO SIGNALS.
Taxicab indicator that helps policemen.

MACHINES ACT AS POLICEMEN

A NEW regulator of traffic so far as automobiles are concerned, has been tried in London. It is a taxicab indicator, and serves as a warning to vehicles in the rear of the movements of those which are immediately in front. The mechanism is contained within a dirtproof metal casing which is intended to be placed in some prominent position on the back of the car. These are three warning signs, one signifying "stop," an arrow pointing to the left, and an arrow pointing to the right. Both the arrows are painted black on separate sheets of glass while the word "stop" is painted mica let into a black background. Half of the front of the case is cut away to allow for the indicator appearance or disappearance of the signals. Underneath the indicator is a loud-toned gong. A single lever is secured to the steering column within easy reach of the driver. Bowden wire is attached to this, and communication with the three separate warning discs in the indicator.

PHOTOGRAPHING LIGHTNING

IN order to get a good photograph of a lightning flash on a moonlight night it is necessary to resort to rather unusual methods. The writer has made a few under just such circumstances.

A large piece of glass is given a thick coating of smoke over a candle flame and then a flash is outlined in the soot with some sharp instrument.

The plate is now placed in front of the camera and surrounded by boxes and backgrounds so that no light will come within the range of the camera excepting that which passes through the outline drawn in the soot on the plate.

When all is ready the camera is opened and a small quantity of flash light powder is burned behind the plate. The effect produced is shown in the accompanying photograph.

FAKEOGRAPH.
Lightning flash that was made by hand.

MILLIONS IN SAND

THIRTEEN million dollars was spent last year in this country just in sand and gravel, and the price ranged all the way from ten cents to twenty dollars a ton. These figures of the Geological Survey include the principal construction work where these materials are used, but of course do not embrace an enormous quantity of sand and gravel used by farmers and small builders, the statistics for which it is impossible to gather. Large and increasing amounts are used in the manufacture of concrete. The price for ordinary sand and gravel runs from a few cents up to $1.50 a ton, but sand employed in making special kinds of glass, molding, etc., brings from seven to twenty dollars a ton. Gravel prepared for roofing is worth as high as three dollars a ton. Washing, drying and screening increases the cost.

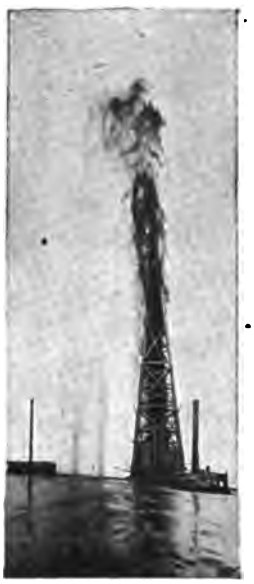
SIGNAL FOR AUTOS.
Police aid installed in London

PROFITABLE GUSHER

ONE of the largest and most profitable oil gushers in the world is the great Lakeview gusher at Maricopa, Cal. The gusher struck the oil sands at 2,300 feet on the morning of Monday, March 14, and in the first two weeks delivered more than fifty thousand barrels of oil a day. It then settled down to an average production of between 40,000 and 45,000 barrels per day.

Before the oil from the gusher could be piped to tanks it had created at its base a huge lake of oil several hundred yards in diameter. The roaring of the gusher can be heard for more than a mile and the oil rises, at times, as much as 250 feet above an eighty-four-foot derrick. The average height of the oil fountain is estimated at three hundred feet. The oil is now streaming up outside the casing.

The bringing in of the gusher was due to the obstinacy of a superintendent who conveniently overlooked the fact that a discouraged board of directors had ordered him to cease drilling. He drilled 47 feet more, then the bit entered the oil sands and the well drilled itself.



HUGE OIL WELL.
One of the world's profitable gushers

INGENIOUS VOTING MACHINE

LANNING ROSS, a blind naval veteran, and a member of the Soldiers' Home at Santa Monica, Cal., is the inventor of a voting and vote counting machine which may bring him both fortune and fame. The blind veteran conceived the idea and entrusted the design to a model maker who, under the supervision of the sightless veteran's deft touch, constructed a model that seemingly works to perfection. The device consists of a till, below which are a series of tubes, one for each candidate on the ticket to be voted. Slots in a frame above the till indicate where the elector must deposit a disk for the candidate whose name is inscribed on a bridge corresponding to each tube. The ballot is secret. The disks do not at once drop into the tube, but for a time remain in a depression, where they may be viewed by the voter. The judge of election pulls a lever, which causes the ballots to drop into their respective hoppers, where they are automatically counted as they drop, and but one disk can be deposited for one nominee.

INGENIOUS VOTING MACHINE.

VOTING MACHINE OPEN FOR INSPECTION.

UNDERWATER PHOTO.
Jelly-fish as taken by submerged camera.

HOW FAST DO WE LIVE?

NO data have ever yet afforded material for a satisfactory statement of the relation between the energy used by animals and the length of their lives; but some animals appear to live at a faster rate than others. For example, the number of heart pulsations varies a great deal—thirty pulsations a minute in the elephant, forty in the horse, fifty in the mule, seventy in man, ninety in the dog, and 200 in the rabbit.

AN UNINTENTIONAL ANCHORAGE.

UNINTENTIONAL ANCHORAGE

STRANDED in the midst of a corn field lies the Ohio River packet, Virginia, one hundred and seventy-five feet from the river channel. That she ever came to rest in such a place seems almost incredible, but she is nevertheless there high and dry and almost beyond recovery.

On the night of March 6th, while pushing her way through an almost impenetrable fog, she went aground near Willow Grove, West Virginia. The pilot groping about in search of the channel caught sight of a light in a farmhouse window which he mistook for the government light, and headed his boat accordingly. Owing to the recent heavy rainfall in the vicinity of the Ohio, it had far overreached its accustomed boundaries, and the boat was run so far out of her course that when she finally went aground it seemed an almost hopeless task to save her.

Arrangements have now been made to float the boat. Repairs have been made and it is expected she will be plying her course between Pittsburg and Cincinnati before long.

In the excitement caused by the boat's going aground one of the crew became panic stricken and jumped overboard and was lost.

NESTS OF WHICH SOUP IS MADE.
Edible swift's nests which the Chinese consider a delicacy.

YACHT SAILS ON SAND.
Englishman has mounted a sail on a rubber-tired vehicle and sails the beach.

MOTOR FOR FARM USE.
Cultivator that operates by motor and is a success.

TRANSFORMING AUTOMOBILES INTO SLEDGES

THOUGH some recent North and South pole expeditions actually have added motor-propelled sledges to their equipment, the problem had not so far been solved in a really satisfactory manner. How lively an interest is taken in this question can be guaged from the fact that the French Touring Club recently organized an automobile-sledge competition and some rather ingenious designs were submitted.

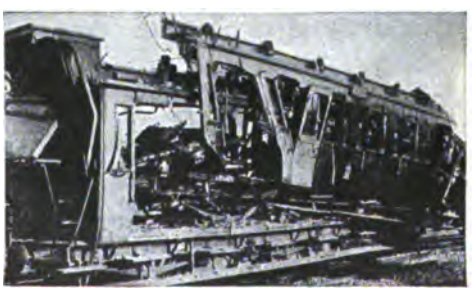
The most successful of these is the one due to Mr. René Le Grain, who obtained the highest prizes of the competition. This system is especially recommendable in so far as it allows any ordinary automobile to be transformed into a sledge, being used alternately as such, and as motor car.

The sliding motion is effected in the fore part of the vehicle by rigidly attaching sledge runners below the wheels, so that they are controlled by the steering wheel.

Only ten minutes are required to mount or unmount the runners, in front of which are fixed snow plows for clearing the road for the rear wheels.

The rear is supplied with wheels and runners both. The rear runners can be raised up from the ground, or take part of the weight, or drop below the wheels and take all the weight as desired. These changes can be made at full speed. The wheels are equipped with chains for traveling on snow, or with spikes for ice traveling.

AN AUTO-SLEDGE.
Device used by French touring club for snow travel.



TELESCOPED CARS.
Strange result of recent collision on an English railroad.

RECORD MASONRY BRIDGE

WHAT will rank as the foremost bridge in France is now being completed for the Bellegarde-Chézery electric railway on the frontier of Switzerland. This railway runs through some of the most rugged and broken parts of the Jura Mountains, following for the most part the stream, Valserine, a tributary of the Rhone. In its route the railway has to cross the stream twice, once by a seven-arched viaduct having spans each of fifty-four feet by 157 feet in height, and the second time by a huge single-span structure shown in the illustrations and known as the "Montagnes" or "Moulin des Pierres" bridge.

At the point where this bridge has been raised, the river runs through a deep precipitous gorge, the sides of which drop down sheer for a distance of some 170 feet. The negotiation of this ravine was at first somewhat perplexing, but investigations showing that the cliffs on either side were of hard stone, Monsieur Picard, the Engineer-in-Chief, decided to build a bridge of masonry and to throw it across in a single span. It was a bold design, for it entailed a structure having a span of 256 feet which at the center is over 200 feet above the stream flowing beneath. Its successful realization meant the establishment of a record in bridge building in France, for this is the largest single-span structure in the country and the third in point of opening in Europe.

ON TOP OF THE ARCH.
One of the world's big bridges nearing completion.

RECORD MASONRY BRIDGE.
Remarkable railway span in the Jura Mountains.

SPECTACULAR OIL FIRE.
Recent conflagration in the fields near Los Angeles.

OIL TANKS A-FIRE

THIS fire photograph was taken several months ago in the oil fields of Los Angeles when eight huge tanks of oil were destroyed by fire. The blaze was caused by a grass fire, a very common danger in California, where the rank grass becomes as dry as tinder in the summer months. As the ground about the tanks is saturated with oil, this spectacular conflagration was the result. A more beautiful and awe-inspiring sight would be hard to conceive than the great vats of flaming, bubbling oil and the enormous clouds of smoke rising from them. At times the oil overflowed and ran as fiery streams in every direction, but owing to the efforts of the fire-fighters only a group of eight tanks were destroyed.

Oil tank fires present great difficulties to the fire fighters and many precautions are therefore taken to prevent their occurrence. These precautions take the form of wide furrows plowed around the ground on which the tanks stand. But even with the greatest care fire often reaches the oil.

UNDERWATER FOG BELL.
Swung from chains and about to be dropped overboard.

UNDERWATER FOG-BELLS

THE variations in carrying power of fog signals, which not infrequently cause mariners a great deal of trouble, has been the cause of sending fog signals under water instead of through the atmosphere. The great advantages that this type of signal has over the air-transmitted signal is not only its comparative freedom from change, but the possibility of locating the direction of the sound within a couple of points. The receivers are slightly back of the bow of the vessel, and, of course, under water. Telephone wires lead to any convenient point, where two ordinary telephone receivers take the sound to the hearer. If a vessel proceeding in a dense fog gets a submarine signal on the port bow, through the port telephone receiver, obviously the sound is to port and not to starboard. The vessel's head is at once turned to port, until the sound is either heard on both sides at once, or disappears, either of which phenomena would indicate that the sound was dead ahead. The vessel is further swung until the sound reappears on the starboard side. By thus swinging the vessel and noting the times and compass points of changing of audibility from port to starboard, a very fair approximation can be had of the direction of the sound. Nine out of ten collisions at sea, resulting from a fog, come from a mistaken sense of the direction of sound.

DEEP RAILWAY CUT.
One hundred and fifty foot gash cut for train passage.

THE NEWHALL CUT

THIS remarkable piece of road building is in the vicinity of Los Angeles and has been the scene of automobile races to test their hill climbing power. The artificial canyon has been gradually cut down by the road builders to lessen the grade, but although they have cut away the sandstone to a depth of more than 150 feet, the grade remains too steep for modern traffic and for this reason a tunnel is being constructed that will go around and under the hill.

The extreme narrowness and crookedness of the cut give it more the appearance of a natural canyon than the work of man.

SMALLEST MOTOR CAR

WHAT is claimed to be the smallest perfect and practical automobile ever built has been on exhibition at the Boston Automobile show and attracted a great deal of attention. After being on exhibition it was run about the streets of Boston by the tiny tot shown in the above illustration and caused automobilists and pedestrians alike to stop and admire the neat little machine. It weighs only 156 pounds.

TINY MOTOR-CAR.
Perfect little machine lately exhibited in Boston.

ENGLISH MOTOR.
New design for side seat on cycle.

A KING'S PLEASURE BOAT

KING THEEBAW was a conservative monarch who reigned over the kingdom of Burmah—a damp and tropical country next door to Siam. Having got into difficulties with the British, a few years ago, he coolly defied that nation of barbarians, and declared that he would chop them into small pieces if they ventured to send an army against him. Nevertheless, as will be remembered, the British did come to Mandalay, Theebaw's capital, and took the monarch prisoner, incidentally acquiring as loot many jars full of rubies, found in the palace. The most interesting relic of the former monarch at present existing is his pleasure boat, which is a gorgeous affair. It is a pagoda-like structure, built on a platform across two boats placed catamaran-fashion. On the bow of each boat is a griffin.

RICH PRIZE

THE Gans line steamship Eureka, running between Boston and ports in Germany, made the richest salvage find on record when she picked up the disabled German steamship Vizarin in mid-ocean and, after one of the gamest towing feats ever performed, brought her safely into port through some stormy weather. Not until port was reached was it found that the steamship contained a cargo conservatively estimated at $3,000,000, and composed of 17,080 bales of the finest Australian wool and other merchandise of great value. The Eureka will receive as a salvage claim at least $100,000, of which every one of the crew will come in for a liberal share. It is claimed that this is the richest find it has been the luck of a sea captain to make in recent years and the captain's share of the salvage charge in this instance will amount to about $15,000.

A RICH PRIZE.
Vessel that was saved with $3,000,000 cargo.

NEW TYPESETTER.
Requires no power and no heat, and sets type rapidly.

WARSHIP FLOATED OVER A SHOAL.
German warship, *Rheinland*, crossing a bar with the help of floating docks.

A KING'S PLEASURE BARGE.
State vessel belonging to the king of Burmah.

CREOSOTED BLOCK PAVEMENT.
This has been found valuable for bridges because light and giving good wear.

THROWING.

AN EXCELLENT PAVEMENT

ONE of the greatest drawbacks of city life is the noise in the streets, and it is quite natural that the public and authorities make every attempt to deaden it. The fruit of these efforts is seen in the adoption of wood pavement found in almost any city of size. The picture on the opposite page shows a stretch of street freshly built with wooden blocks; it represents the Williamsburg Bridge in New York City. Both roadways of this magnificent structure are paved with creo-resinate wood blocks. Each roadway is paved with special grooved block, four inches deep, with the exception of a 600-foot level stretch in the center of the bridge. The grooves of the special block are filled with fine gravel and asphaltic cement.

NEWEST BREATHING APPARATUS

OUR picture shows a new breathing apparatus for aeronauts, which has proved very successful, and enables the ascension to great heights. The oxygen is contained in two steel cylinders, which can be used either together or independently, and which by means of tubes are connected with a face mask having two valves, which automatically allow the impure air to escape, or the oxygen to enter. In order to prevent the weight of the tubes from pulling down the mask and to insure freedom of movement to the aeronaut, the tubes are raised and placed over rollers before being connected with the mask. The oxygen in the cylinders is, of course, under a very great pressure (up to 125 atmospheres), which is lessened by means of reduction valves.

CATCHING

FRENCH IMITATION OF THE BOOMERANG.
Invention that has the same characteristics as the famous Australian weapon.

NEW BREATHING DEVICE.
Device for balloonists' use at high altitudes.

SWAN-SHAPED MOTOR-CAR.
This odd design was made in England for use in India, and cost $12,500.

COLOSSAL CHESSBOARD.
Used in London for benefit of audience at English end of International Match.

MICROSCOPE MERRY-GO-ROUND.
Turn-table which enables several workers each to study several slides in quick succession.

MICROSCOPE MERRY-GO-ROUND

DR. M. NEISSER, Professor at the Frankfort-on-the-Main Hygienical Institution, has designed what he terms a microscope roundabout. This is a large round, rotating table on the periphery of which the microscopes are installed. The table is made of welded iron throughout and is running in ball bearings. Twelve inverted incandescent mantle lamps taking part in the rotation, are used as illuminant, the sockets of these lamps being so designed as to cause the light to fall only downward on the microscope mirror without exerting any blinding effect. The extreme circumference of the table, which is coated with linoleum, forms a narrow wooden edge, which does not rotate, and on which the experimenter may rest his arms.

Below the edge of the table is arranged a simple braking device, which by a pressure on a knob is made to disengage the table thus ensuring a smooth rotation. This braking device has obviously to be free from any ratchet wheels, lest the suddenness of the braking effect set up vibrations of the table. Close to this device a button bell is arranged below the edge. Simple handles distributed over the table serve to effect its rotation.

The bell signal indicates the moment the miscroscope should be disengaged for rotation, after which the table is turned round the distance between any two seats.

The accompanying illustration shows how easily twelve preparations may thus be demonstrated in a short time; moreover, the distance between the seats allows sufficient room for an additional observer standing beside his colleague in order to use the instrument alternately. It will also be understood that eleven microscopes allow an unlimited number of preparations to be demonstrated, provided an assistant posted on the twelfth seat be entrusted with the task of exchanging the preparation of each microscope as it reaches him.

This is especially adapted for the use of colleges.

CLIMBING THE MATTERHORN BY WIRE.
Cableway that has been strung up the face of this famous mountain.

RAISING A SUNKEN CRAFT.
How the pumps are used to empty a waterfilled vessel to float her.

SHADOWS THAT LIVE

THE accompanying photograph furnishes a view of a "sump hole" at the oil field located in Kern County, Southern California. The field promises to become one of the great petroleum producing regions of the State. One very remarkable feature about the reflections at this hole is the fact that after the object casting the shadow moves from the identical spot, or is moved away, the shadow remains for some seconds in the *same place,* without following the substance—or, *changing* its position—in the least. Usually the shadows remain all the way from five to ten seconds after the substances have changed position—fading away, and finally disappearing altogether. The longer the shadow is cast in *one particular spot,* the longer it remains there. Very careful investigations of this remarkable peculiarity have been made, and the explanation given is that when the crude oil first is pumped up into the "sump holes"—or temporary earth reservoirs — it is very heavily charged with gas. After remaining in the reservoir for a short time it becomes quite warm from the sun's rays, and the gas is rapidly disengaged from the heavy body of petroleum, and rises to the surface, and passes off into the atmosphere. Millions of minute bubbles are constantly rising to the surface of the crude oil — especially when the sun pours down its fervid rays. This gas is extremely volatile and sensitive to the condition of temperature. So very sensitive is it that whenever a shadow is cast on the surface, and to a certain extent lowers the temperature on that particular spot, it lessens the number of bubbles that rise. This effect serves to emphasize the shadow cast. When a person stands for a few minutes in *one* spot, and then suddenly shifts his position his reflection will still be indicated in the same place. The smaller number of bubbles of gas rising to the surface causes the surface to have a different color than the surrounding oil. The uncanny effect is the cause of much wonderment.

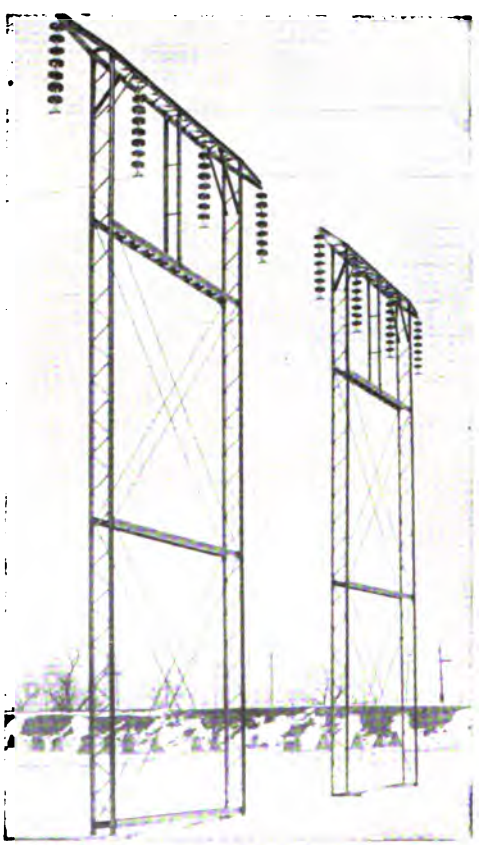
SHADOWS THAT LIVE.
Place where shadows persist after object is removed.

NEW CATTLE-GUARD.
Interesting invention to prevent cows straying upon railroad tracks.

AUTOMOBILE IN STREET-CLEANING.
Motor-cars used in New York for hauling away huge loads of snow.

ENGINE DERAILED BY ICE.
Locomotive lifted and turned over by Jack Frost's work on rails.

WHERE BIG WARSHIPS ARE BUILDING.
American yards in which $22,000,000 worth of Argentine battleships are being constructed.



INSULATING HIGH VOLTAGE WIRES.
New idea in handling lines that carry high pressure current.

CURIOUS ACCIDENT

A WRECK on the Susquehanna, Bloomsburg & Berwick road took place on Feb. 18th last from an unusual cause. The rain and sleet that fell during the night of Feb. 17th so thickly coated the rails that the heavy locomotive, drawing a passenger train, could not cut it and simply ran over tops of the rails to one side, a distance of about twelve ft., when it was overturned. The accident occurred near Jerseytown, Pa.

BIG BATTLESHIP ORDER

WITH contracts for building two Argentine battleships and six turbine engines, the two orders being worth considerably more than $22,000,000, the head of a Quincy, Mass., shipbuilding firm recently arrived from abroad. This is the biggest prize yet landed by an American shipbuilding company in competition with all the other nations of the world. Some idea of the odds against which the domestic shipbuilders of the U. S. worked may be gained from the fact that nearly every shipbuilding concern of any importance in the world sent personal representatives to bid for the enormous contract, and English, French, Italian, and German shipbuilders were represented in the try for the big Argentine contract. The view herewith shows a general view of the docks and works which have already begun the plans for the battleships and turbines, and the head of the firm expects to have the order completed in two and one-half years.

HIGH VOLTAGE LINES

THE accompanying photograph represents an entirely new idea in the support of high voltage line wires, the purpose being not to bring the tension of the line on any one of the supports but rather to support the real weight of the conduits on each one of the steel transmission towers. It will be noticed that this type of transmission tower differs widely from most of the steel towers used at the present time in that the supporting insulator chains allow a considerable amount of freedom to the swinging of the

wires and at the same time act as a very reliable support. No transmission towers of this type have been put in actual use as yet and the photographs shown were taken of the experimental line which was erected by the makers. The insulating chains are novel, being composed of alternate concave discs of porcelain and galvanized links. The supports of this type are designed to carry and have carried, in experiments, 200,000 volts.

NEW GOVERNMENT SUBMARINE

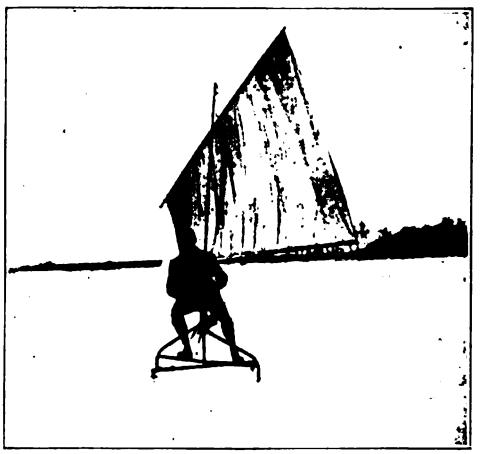
THE submarine boat "Salmon" was recently launched after Miss Eunice Fitzgerald, the christener, had broken the inevitable bottle of wine on the steel side. This is the latest addition to the submarine department of the United States Navy and represents many improvements that have been made since the launching of the last submarine that was built for the United States about a year ago.

This submarine uses both the vertical and horizontal rudder, instead of the ballast system of regulating the depth to which the boat is wanted to go. It is propelled by electric power and is provided with a new type of periscope for use in steering when the craft is near the surface. When in deep water, steering is done by the compass. The government trials of the boat will be made shortly.

ICE-BOAT AND CYCLE COMBINED

THE sailing craft represented in the accompanying figures, has been recently invented by a German artist, Mr. W. Fopke of Charlottenburg. It combines features of ice-yachting with those of cycling, the driver's seat being arranged so ingeniously that sledge runners are readily substituted for a cycle frame. The fact that the apparatus is steered with the foot and balanced by the weight of the body adds a further factor of sporting interest, the more so, as this unique steering device insures far more delicate effects, thus increasing, in connection with the lower friction, the speed and ease of manoeuvering.

UNCLE SAM'S NEW SUBMARINE.
Launching of the *Salmon*, the latest addition to our underwater forces



CYCLE TURNED TO ICE-BOAT.
Ingenious idea for doubling the uses of a simple device.

SAILING ON LAND.
On wheels or on ice, without wheels, this craft travels by wind-power.

"MAN OVERBOARD"

THE illustration shows an accident in mid-ocean to one of the life boats on the steamer *La Savoie* of the French line. A man fell overboard and an attempt was made to launch the life-boat in a hurry, with the results shown. The falls got clogged at one end, due to careless handling or rusty blocks. Notice that the upper block is broken, as corroded bearings prevented the block from turning when the davit was swung.

Unfortunately this is not an uncommon accident on ocean liners. In this case no one was in the boat except a man at each end to unhook tackles. But similar accidents happen to boats loaded with passengers.

MID-OCEAN ACCIDENT. Life-boat broken loose from one davit in being lowered at sea.

EARTHQUAKE OBSERVATORY BUILT BY PRIESTS

WHEN we think of a seismological observatory, we picture instruments of the greatest precision and finest workmanship. However, one of the most noted observatories for studying earthquakes is the one at Cartuja, Spain, which is entirely equipped with instruments made by the Jesuit Fathers. The instruments are very complete and were made from very simple materials. There are five instruments; those here illustrated were constructed in the workshops of Cartuja by the Fathers themselves.

The weight of one is composed of an old kettle heavily weighted. For the weight of another some remnants of plumbing pipes were used, and sheets of tin for registering cylinders, which are moved by means of simple alarm clocks. The clocks, in fact, were the only actual expense.

STUDYING THE EARTHQUAKE. Device made from simple materials.

NEW SEISMOGRAPH. Instrument designed by Jesuit Fathers.

The many different seismic movements require a variety of instruments, each being designed for a special study. There are volcanic earthquakes, the explosive, the horizontal, the rotary, and vertical movements. The commonest type is the horizontal. One of the instruments is intended for distant earthquakes. One may judge of its sensibility by recalling the disaster at Messina. The earth waves so affected the instrument that sometimes the needle came out of the registering cylinder.

IMMENSE OIL PIPE LINE

TO circumvent expensive hauling of fuel over the Techachapi Pass, the Southern Pacific Railroad will build a large pipe line across the mountains from Bakersfield to Mojave at a cost of more than $2,000,000.

It will be of 10-inch rifled pipe with a sub-pumping station every ten miles up the grade from Bakersfield to the summit of the railway. There a tunnel will be run through the mountains near the long one now used by the trains. The line for the pumping system has been surveyed, and the pipe contract let to a Pittsburg company.

Conservative engineers estimate that this pipe line, with the extensive tunneling required, will cost not less than $15,000 per mile, and the line will be 68 miles long. The pumping stations will cost $45,000 each. It would not be surprising if the total cost will reach nearly $3,000,000.

ELECTRIC AUTOMOBILE HORN

WITH the use of the storage battery and small dynamo on the modern motor car for ignition purposes as well as for lighting, electric current is available for working a horn on automobiles to advantage.

The electric siren has become popular in Germany and is extensively employed on up-to-date automobiles. The accompanying illustration shows a German electric horn with the electrical connections enclosed in a flexible steel armored conduit arranged in three sections with a central junction box. One of the flexible steel conduit leads is connected with the contact button and mounted on the steering wheel while another is placed at a convenient position along the side and front of the car and connected with the electric horn, as noted at the left in the photograph. The third flexible steel cable from the junction box contains two conductors with terminals for connecting with the storage battery, which lights the car or is employed for the ignition system.

ELECTRIC AUTO-HORN. New invention for warning pedestrians.

MAGIC DOOR OPENER

ONE of the novelties shown at the Ideal Home Exhibition recently held in London was the so-called Magic Door Opener, a clever contrivance which can be fitted with ease and at small cost to any door. The apparatus is chiefly designed for the use of servants when carrying trays of food, or other articles. As will be seen by the accompanying illustration the domestic has no need to call for the door to be opened or to balance the possibly heavy tray on her knee every time she endeavors to open it herself. All she has to do is to touch a spring with her foot near the bottom of the door and walk in.

AUTOMATIC DOOR OPENER. A touch of the foot does it.

SAVES MAID OR HOUSEKEEPER MUCH TROUBLE.

SWISS NATIONAL PARK

THE establishment of a national park in Switzerland on the plan of the Yellowstone National Park in the United States, which has been agitated by patriotic Swiss citizens, societies, and newspapers, is proving effective.

The proposal has been indorsed by the government, and a definite plan of action adopted, which promises to result in the acquisition for park purposes of a large and suitable tract of territory in one of the most picturesque and attractive parts of Switzerland. After numerous investigations and journeys to different localities and the consideration of various propositions, it has been decided to acquire a large tract of land in the most secluded section of the Grisons, including the Chuoza Valley, in the heart of the Engadine, where nature is still in primitive state. The site selected is at the foot of the Piz Quatrevals, on the border of Italy, and is admirably suited for park purposes, being rich in rare botanical and geological specimens and situated in a high altitude, with a healthful climate, and in the midst of beautiful and romantic scenery in a country famous for its mountain views and rich in legend and historic lore.

CLEANING STREETS BY VACUUM.
New apparatus that is now in use in New York.

NEW YORK STREETS CLEANED BY VACUUM

MANHATTAN'S "white wings" will soon be running automobiles instead of dodging them if the tests now being carried out by the street cleaning department of the City of New York prove successful. The machine under test is a vacuum sweeper which picks up the dirt and dust from the streets by suction. It is mounted on an automobile running gear by which it is propelled along the street, the engine also driving the suction fan to create the vacuum.

In addition to the rapidity with which the streets are cleaned by this machine, a further advantage arises from the fact that no dust is stirred up, as is inevitable with the ordinary methods of street sweeping. As will be seen from the illustration, two men are required, one to act as chauffeur and one to control the sweeper.

SINGLE TUBE RAILWAY.
Clever invention of Englishman for transportation.

NOVEL SINGLE TUBE RAILWAY

A DEMONSTRATION of what is known as the Kearney single-tube high speed railway was lately given by means of a model of the invention at the Crystal Palace, London. As the accompanying picture shows, the cars are run upon a single bearing rail and are kept upright by means of a single overhead guide rail and supported by standards 60 feet apart which, it is claimed, make derailment impossible. It is also contended by the inventor that the railway could be constructed at half the capital cost of those at present in vogue and run at double the speed at half the working expense. No lifts would be required, as the stations would be immediately below the surface of the ground. The trains could travel at a maximum speed of fifty miles an hour. The system is to be employed on the line which is to be constructed from the Crystal Palace aforesaid to the Strand, in the heart of London, and at one section of the line it is claimed that the train will be able to travel, with perfect safety, at ninety miles an hour.

No gyroscope is used but there will be but little pressure on the upper rail at high speed.

THE "FLOOR" OF A SHIP.
Steel false-bottom laid in an English ocean carrier.

MODERN RAILWAY ELECTRIC HEADLIGHT

THE accompanying illustration shows the remarkable effect of the electric headlight as utilized on locomotives for illuminating the track and roadbed for the benefit of the engineer.

The photograph was taken on the line of the Chicago, Rock Island and Pacific Railroad, about 9 o'clock at night, with no other light than that of the headlight, and it will be noted that the station is distinctly seen one-half mile from the engine.

A steam turbine and dynamo are mounted with the headlight on the front end of the locomotive forward of the stack and occupy a space of about two feet square. The turbine and dynamo supply current not only for the arc lamp of the headlight but for three incandescent lights in the cab, the current being conducted to the latter through wires laid in the wooden hand railing from the front of the locomotive to the cab.

EFFECT OF ELECTRIC HEADLIGHT.
How the tracks look ahead of a locomotive fitted with new light.

LUXURIOUS STEEL YACHT

THE accompanying photograph shows one of the largest steel yachts ever manufactured as she went down the ways at the Fore River Yards at Quincy, Mass., to be christened the *Aloha*, the flagship elect of the New York Yacht Club.

This craft is one of the most luxuriously equipped yachts that has ever been put out, the saloons and guests rooms being finished in teak and mahogany. The machinery is arranged amidships, the quarters for the crew being in the commodious forecastle and the rooms of the owner and guests occupy the after part of the yacht. Composite deckhouses of seamless steel finished on the inside with teak are built on the main deck enclosing entrance stairways and deck saloons.

A novel feature in the vessel is the telescopic smokestack which is necessary when the vessel is under sail. Altogether the yacht *Aloha* is one of the largest and handsomest steam yachts afloat and will worthily fill the place of flagship of the New York Yacht Club.

NEW GERMAN FIRE APPARATUS.
Extension scaling ladder that is handled by a crank from trucks.

LUXURIOUS NEW STEEL YACHT.
Aloha, flagship of the New York Yacht Club, recently launched.

MISTLETOE A FOREST PEST

THE report of the Department of Agriculture that in some localities mistletoe is so abundant upon trees, and so harmful to them, that its extermination or control is a serious practical question, will doubtless prove something of a surprise to that large section of the population that knows that parasite only as an adjunct of Christmas decoration.

Fortunately the plant is of very slow growth, so that years are required for a bunch of the parasite to develop into sufficient size to seriously injure the growth of the branch to which it is attached. In the end, however, the portion of the branch beyond the point where the mistletoe is growing becomes starved and dies. Where many bunches of mistletoe grow on the same tree, it is only a question of time until the tree itself will die. Throughout the regions in which the plant flourishes, many trees may be seen that are literally burdened with mistletoe, but scantily supplied with their natural foliage. They are being literally starved to death, as the parasites absorb so much of the sap that there is an insufficient quantity left for the growth and sustenance of the tree.

Probably the only way to get rid of the mistletoe, in regions in which it is so abundant as to constitute a real menace to the forests, is to cut down all trees that are bady infected, and to cut from all others branches upon which it has taken root. This would prove a herculean labor, and would be so costly that it is not likely to be soon attempted.

DRYING RAISINS FOR MARKET.
Typical scene in the California fields.

RAISINS FROM THE GOLDEN STATE

WITHIN the last few years, California has become a producer of raisins on an enormous scale. The business is more scientifically conducted there than anywhere else in the world, and the output commands high prices, not only because of its fine quality, but also by reason of the neat way in which the dried grapes are put up.

California growers, indeed, have specialized on these points, to their great financial profit. Also, they take great pains that all the processes employed in preparing the fruit for market shall be as cleanly as possible. Imported raisins, from Europe, are usually put up without regard for any such considerations — a remark that applies especially to the small seedless grapes known as "currants," which, coming mainly from Greece, ought really to be disinfected.

MISTLETOE A PEST.
Abundant growth on tree harms the tree itself.

SIGNING CHECKS BY MACHINE

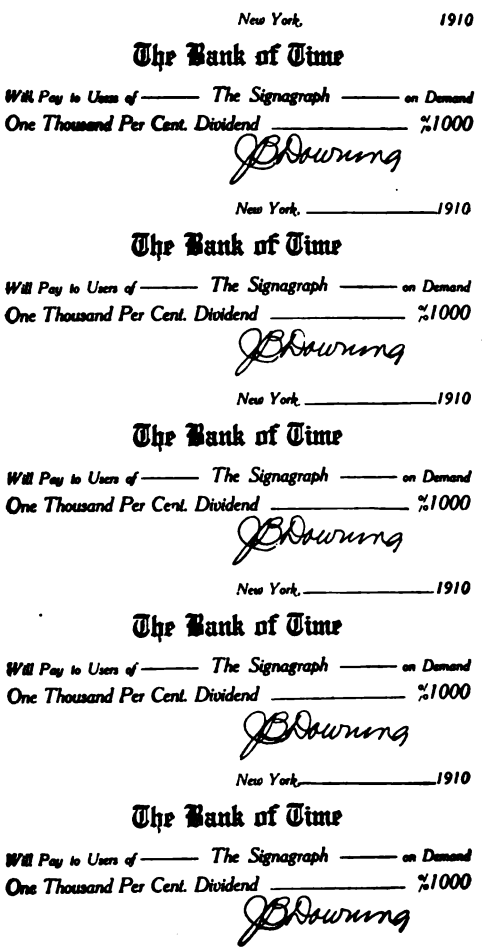
IN modern business establishments every precaution is taken to guard the valuable time of the high-salaried executive officials. In one respect the president or treasurer of a great corporation is at times more burdened with perfunctory work than the least important clerk, and that is in the labor of affixing his signature to checks, stock certificates, and other pieces of paper that stand for money. At dividend paying time important officials must spend large parts of several days in succession in simply writing their names over and over again, to the exclusion of other work.

The machine illustrated herewith has been introduced to lessen this expensive labor by causing the movement of the pen, held in the fingers of the signer, to execute ten signatures at once.

The machine consists of a substantial steel writing table on which is arranged a "monitor pen," which is handled in the usual way. This pen, however, does no direct writing. Instead, it is connected by a flexible joint to a light aluminum frame, supported on almost frictionless roller bearings so as to move with the utmost freedom in any direction in the horizontal plane. Ten separate fountain pens are secured to the frame, spaced at regular distances apart and slanted at the best writing angle. The papers to be signed are placed on a flat bed below the frame. By a simple pantograph mechanism the frame follows every slightest movement of the monitor pen, so that a signature executed by the latter is simultaneously written by each of the ten pens, giving ten identical signatures.

The writing bed consists of a rolling frame with spring receptacles for four piles of sheets. When the top sheets of two adjacent piles are signed, by the single operation described, the frame is shifted along, on its rollers, to bring the other two piles of sheets under the battery of pens for signing while an assistant is removing the top sheets of the first pile.

MACHINE THAT SIGNS CHECKS.
Device for saving labor of much handwriting of signatures.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SIGNATURES MADE BY MACHINE.

SUB-SURFACE TORPEDO BOAT

THE first of the two sub-surface torpedo boats authorized by the act of Congress last year has been completed by a Boston shipbuilding firm. In the preliminary trials this boat made 16 knots, and proved herself a very stable craft under almost any weather conditions.

This new type of boat requires a crew of only two men and has a cruising radius of 200 miles, propelled by an eight-cylinder gasoline engine. Essentially this sub-surface boat has two parts, the submarine shell, situated well below the water line and containing all of the machinery and torpedo armament, and the floating portion on the surface from which the submarine portion is suspended. The latter part is made unsinkable by its being filled with compartments stuffed with cellulose and surrounded with armor plate.

The boat may be used to discharge the ordinary eighteen-inch torpedo from a bow tube or it may be steered to within a short distance of the objective and aimed at it, the crew making its escape in lifeboats. A rather hazardous but very effective method.

The principal function of this new type of small fighters will be to protect harbors and the general coast line of the country in case of war. These boats may also be carried on the decks of the battleships and used in the event of a night attack for ramming the enemy's vessels.

REMARKABLE TRAIN FERRY
Big boat that transfers cars between Germany and Sweden.

REMARKABLE TRAIN FERRY

THE accompanying illustration shows a most interesting train ferry on its way from Sassnitz in Germany to Trelleborg in Sweden, a distance of nearly seventy miles. It crosses the Baltic Sea which is at times very rough and is therefore one of the most remarkable train ferries in the world.

The *Drottning Victoria*, of Trellenborg, seen in the illustration under full speed measures 354 feet in length and has a beam of fifty feet. She is provided with luxuriously equipped parlors, smoking rooms, cabins and state rooms for passengers who do not occupy sleeping cars. The trip is made in four hours, the speed being sixteen knots per hour.

NEW TYPE OF TORPEDO BOAT, KNOWN AS "THE SUB-SURFACE" TYPE AND MANNED BY A CREW OF ONLY TWO MEN.

HUGE BELLS HAULED BY MOTOR TRUCKS

THE use of three German gasoline motor trucks for conveying church bells from Karlsruhe to Mannheim is shown in the accompanying illustration. In Germany as well as in other European countries the automobile truck is utilized extensively in place of the railway for short-distance freight transportation of heavy castings and other material. It is stated that the combined weight of the five church bells shown in the accompanying illustration amounted to no less than sixteen and one-half tons and the cost of transportation in this manner was considerably less than by steam railway freight service on account of the additional expense for time and labor in loading and unloading.

Undoubtedly with the increased capacity and speed of modern American motor trucks and with the better roads under construction through the different states, the motor car will be utilized to advantage in many cases in this country for short hauls and delivery of heavy goods, where previously this class of heavy freight was handled exclusively by the steam railways.

FIRST OF NEW TYPE OF TORPEDO BOAT DESTROYERS FOR UNCLE SAM.

NEW AMERICAN DESTROYER

THE first of the large new type torpedo boat destroyers that are being built for the U. S. Navy was launched at the Fore River yards, Quincy, Mass., and christened the *Perkins*.

The *Perkins* is a sample of the new enlarged type of ocean going destroyer capable of keeping the sea with the battle fleet, and since the three vessels of this type were designed for the United States other first-class naval powers have followed suit in laying down plans for similar craft.

The upper work of this vessel is practically all flush with the first deck, giving the craft a lowness to the water that is desirable in offering as little for a target as is practicable. The ship is driven by two Curtis reversible marine turbines, each developing 6,000 H. P. and giving the vessel a speed of 29½ knots. It is expected that this speed will be exceeded in the trials as the turbines can handle a considerable overload.

BIG BELLS HAULED ON MOTOR TRUCKS.
German motors convey new church chimes from Karlsruhe to Mannheim.

ORANGE CULTURE IN PALESTINE

THE Jaffa orange forms one of the most important of the exports from that sacred historic port of Palestine. It is admitted by connoisseurs, even those from California and Florida, where some of the choicest oranges are grown, that the Jaffa orange is surpassed in excellence and delicious flavor by none in the world.

The ancient town of Jaffa is deeply fringed on all sides, except seaward, by the broad green expanse of orange orchards. In the time of the orange blossoms the air is heavy with their perfume, which reaches far out to sea and envelops passing steamers. No other industry of this region compares in importance to the cultivation of the orange. It gives employment to thousands of the inhabitants. New gardens are continually being planted, and the area devoted to this industry increased. The planting and pruning of the trees, the opening of the irrigating ditches, the care of the irrigating plants, the picking of the fruit, its sorting, wrapping in tissue paper, packing in boxes, and the manufacture of these boxes, which are turned out by the hundred thousand, the transporting of the boxes, filled with the yet green fruit, on the backs of camels to the port, the loading of them into lighters in which they are carried to the steamers, which have come expressly for a cargo of this fruit, are all involved in the industry.

THE ORANGE SHIP.
Scene in the trade in golden fruit in Palestine.

CORNSTALK DWELLING.
Cheap home of Mexican on our Southern border.

Until late years the water for irrigating the gardens was raised from the large deep wells by a process which has been in use in the Orient for thousands of years. A camel or horse or mule, blindfolded, turns a huge upright axle, which rotates a horizontal axle by wooden cogs, and this carries on its other end immediately over the well other crude cogs that engage an endless chain of buckets, bringing them up full of water, to be emptied into a trough, by which the fluid is carried to a large masonry reservoir, and from which it is drawn off to all parts of the garden.

MEXICAN CORNSTALK DWELLING

IT is said that a Korean can work miracles with a bundle of straw. So, too, a Mexican can find many and some most astonishing uses for the corn, and all that enters into its composition. His sandals and those of his wife and children, the bridles by which he guides his burros, the cape that shields his shoulders from the rain, the mats on which he sleeps are made of its shucks. The stalks and blades he feeds to his stock. His fences, too, are made of its stalks woven into a framework of bamboo and vines. Receptables for clothing and

OLD WATER WHEEL.
Curious relic of the past at Troy, N. Y.

various crude pouches for holding all sorts of household stores are formed of its cobs. The grain, soaked in lye, crushed between stones, rolled into soft masses of dough, and baked on earthenware griddles into hard cakes called *tortillas,* constitutes the chief source of the food supply of himself and family. But perhaps the most novel use of all is to construct of the refuse of the corn field his dwelling entire.

In some of the tropic portions of Mexico corn often shows such vigor and grows to such a height, that the stalks, in addition to being fifteen feet or more in length, are as large around as a well developed man's arm below the wrist. Thus they form a much more substantial framework for the thatched roof and walls of a farmer's hut than one would suppose.

BIRD CASTLE BUILT BY BLIND MAN

THIS seventeen-room bird house was built by a blind author and naturalist, John T. Timmons of Cadiz, Ohio. Mr. Timmons is a bird lover and student of nature who believes in the protection of insect-destroying birds, and in his written work as well as in the work of his hands is doing his best to care for them.

This bird castle was constructed by the sense of touch alone. It contains 600 pieces of wood and weighs about 200 pounds.

The structure is of his own design and shows a remarkable sense of grace and proportion for a man deprived of his sight.

AN OLD WATER WHEEL

A REMINDER of the early days of a mighty industry is the old Burden Water Wheel which stands in the southern part of Troy, N. Y.

Mr. Henry Burden, in 1838, designed and erected the wheel to generate power for the operation of his iron works, the products of which were chiefly horseshoes and railroad spikes. Many of the horseshoes used by the United States Army during the Civil War were made at the plant operated by this wheel. Millions of spikes manufactured here have been used on railroads in all parts of the country. The wheel has been in operation till a few years ago.

The wheel is one of the largest in America, being sixty feet in diameter. Its buckets are twenty-two feet long by six feet in depth. When running at a speed of two revolutions per minute it generated from 500 to 600 horse-power, and was capable of producing 1,200 horsepower.

One of the unique features of the old wheel is its construction. It is a rolling cylinder rather than a wheel, the weight not being borne at the center but supported from beneath by two shafts.

BUILT BY A BLIND MAN.
Bird castle constructed by sightless worker.

PHOTOGRAPHING FISHES

COMPARED with the knowledge we have of other animals very little has been found out about fishes, for instance, it is still a matter of dispute, whether or not fishes sleep, and also little is known of their sense of smell. This lack of knowledge is largely due to the fact that unlike other animals, fishes can not be watched in their natural surroundings, the deep water.

Even the largest aquariums will not give a correct idea of the habits of fishes, as it has been found out that when confined, fishes quite often change in their ways and become tamed.

Naturally the camera has been thought of as a means for watching fishes in their element, and although great obstacles have to be overcome, through persistency some good pictures have been obtained as the accompanying photographs show.

THE STICKLE-BACK.
Fish swimming with young in its own haunts.

THE VEIL-FISH.
Underwater photo of a strange species.

through the one end of which a rod extended, allowing the photographic plate to be brought nearer or farther away from the lense on the other end of the tube, so that the focus could be regulated.

As it was found out that when lowering the camera into the water, dampness would overcast the plate, the air in the cylinder was dried by means of chloride of potassium.

In order to concentrate the rays of the camera, and to prevent outside light from distracting them, a large tin cylinder was placed in front of the lens. The opening of the shutter was effected either pneumatically or by means of an electro-magnet.

For artificial light, explosive powders were used, magnesia, for instance. This apparatus was either taken down to the sea bottom by the diver, or if the ground was muddy, and the diver by his movements liable to cloud the water, it was lowered from above.

This method of submarine photography to fish-culture, or more accurately expressed by the term "aquiculture," now current in France, since the modern fish-culturist gives attention to many important objects of fishery besides fish, for example, the crustaceans, mulloscs, corals, sponges, algae, and the various forms of life below the surface of the sea. This method will doubtless result in some startling discoveries of submarine life.

SUB-MARINE PHOTOG-RAPHY

THERE were recently taken in France some very interesting photographic submarine pictures of unexcelled beauty and clearness for a scientific work, dealing with animal and vegetable life of the sea.

A camera was especially constructed for the purpose. It consisted of a waterproof steel cylinder made of sheet metal,

THE SEA ANEMONE.
A submarine photograph.

ACTINIAS ON OCRAN BOTTOM.
Taken with submerged camera.

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¶ Has it occurred to you while boycotting the packers that you need not deprive yourself of the choicest of flesh foods? John L. Cowan give us a tip—and a mighty important one, at that—on how to circumvent some of the present high prices. He makes you acquainted with many new foods.

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¶ All astronomers admit that there are tremendous geological changes taking place on Mars at the present time. Are the new fissures, so rapidly appearing on its surface, additional canals being dug by the frantic Martians to divert the overflow of seas and lakes that have been driven from their customary beds? This article by F. A. Talbot will act as a fillip to the most jaded imagination.

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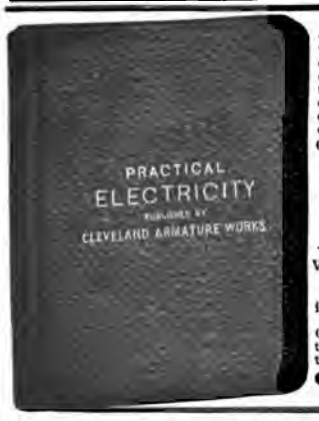

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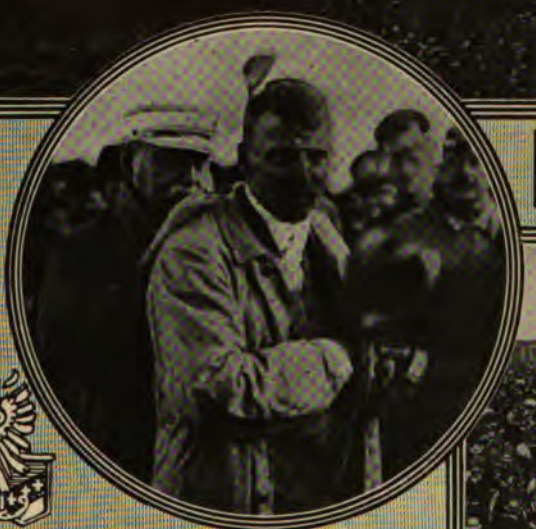
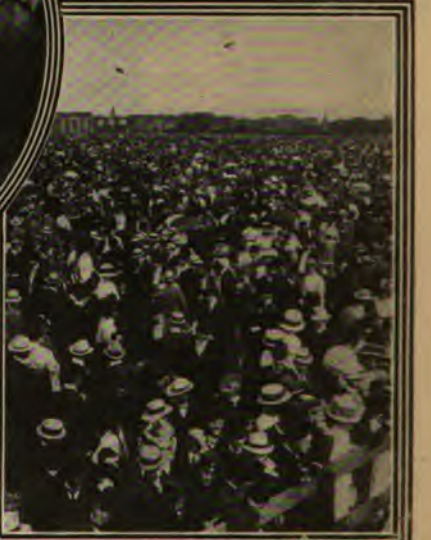


Count Zeppelin.



Watching the Craft.

Count Zeppelin and His Airship Officers.

The Ship on Her Voyage.

SCENES CONNECTED WITH COUNT ZEPPELIN'S AIRSHIP AND ITS FLIGHT.
The inventor is regarded everywhere as a national hero.

THE TECHNICAL WORLD MAGAZINE

VOL. XIII. AUGUST, 1910 NO. 6

MAKING A BUSINESS OF FLYING

By

T. R. MACMECHEN AND CARL DIENSTBACH

"Z. III, sailing at 3:30 P. M. for Mannheim." The airship's orders were more like a fancy of Jules Verne than reality to the writers in the summer of 1909, at Frankfort-on-the-Main. It was the year of Count Zeppelin's final tests before beginning regular air-traffic this summer. A throng of placid Germans scanned the bulletin board as they would a railway or steamship time table. "What about the weather?" A startled Teuton glanced with surprise at the skeptic, saw he was from America, and replied, "If you are going, be here; Zeppelin sails weather or no weather." That had the convincing sound of near air-navigation.

At 2:30, a gale swept over the "air-harbor," a long, massive building like a steamship pier, that held 450 feet of airship. The morning had been rainy, and heavy gusts stiffened the flags. As sailing time drew near, it brought a strong windstorm. Balloons on the grounds were rocking from side to side; spectators held on to their hats. Fashion arrived in touring cars. Those who were "booked" for the air-voyage seemed to be familiar with sea-travel. The men wore yachting caps, the women long storm coats and hats battened down by veils. Marine binoculars and small cameras were slung from the shoulder.

This nautical atmosphere deepened inside the air-harbor where a large corps of "air-men" made ready for the voyage. One immediately lost all idea that the aluminum skeleton of this mammoth hull encased in cloth, was simply stowed with great gas-chambers and floated like a balloon. A chain of anchors hung from the bows. Coils of rope lay along the decks of the fore and aft motor cars, resembling steam launches in size and appearance. These were of solid aluminum, with gunwales having sideports and gangways for going aboard. Narrow footways of the same material passed between both cars and the cabin space amidships. Twenty-seven noisy passengers and friends who were seeing them off, clambered along a slender rail toward staring mica ports of a semi-circular door set in a bow-shaped companionway, which cuts the winds so it does not impede the ship's flight, and prevents drafts from sweeping the long cabin which is provided with leather divans along the sides. Though this enclosed space is only ten feet wide, its 250 feet between cars was like walking the long passageways from salon to smoking room, on a steamer. The impression was intensified by side ports, in sponsons, converting the cabin, amidships, into an open promenade deck, in fair weather. Even more convincing

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AEROSTATIC SWITCHBOARD OF THE *ZEPPELIN III.*
Orville Wright is seen at left in a stiff hat.

were the excited passengers' voices from remote parts of the craft.

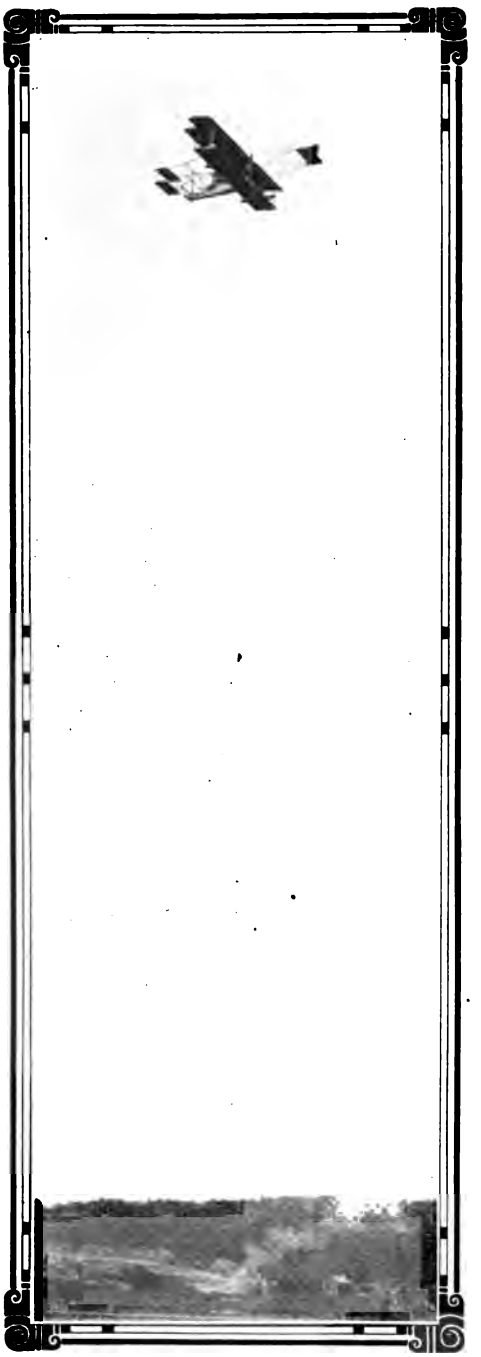
The purser, a newly created official, was the guide on a rapid inspection. To port and starboard the space running the length of the gangway has become twenty snug staterooms and a salon that Prince Henry, president of the Zeppelin Polar Expedition, recently found as well appointed as any cabin de luxe. One's outstretched fingers brushed the ceiling formed by the bottom of the big hull. The front motor car, or captain's "bridge," has a forward half-deck, used as a chart desk; among its navigation maps was a well-thumbed chart of the course of travel. A ship's compass sets in this desk, before which the pilot, in service uniform, shapes a perfect course by two steering wheels that control the vertical rudders, swinging astern on both sides, between the big stability fins—those "feathers" that direct the craft's arrow flight. Another helmsman, to the starboard, attends two wheels working fore and aft sets of "stepped" aeroplane rudders, which resemble Venetian blinds. These send the airship up and down, if the motors are driving it forward; and instantly check the ship from rising or sinking, as the gas fluctuates. For aerostatic navigation, a switch-board controls the various gas-valves and water-ballast tanks, and holds the chronometer, an automatic statoscope that indicates the ship's height, and a barograph that constantly forecasts the weather. A

OPEN SIDE PORT ON THE PROMENADE DECK OF *Zeppelin III.*

dial with three arms, Count Zeppelin's own invention, shows the ship's speed through the air, over the ground, and the wind's speed over the earth; and enables the pilot to read the exact course to steer, in any wind, to reach an airport.

A high platform on wheels took the chief engineer around 1,000 feet of hull, inspecting rudders and propellers. Three assistant engineers were oiling, polishing and testing bolts and screws on two sets of trim motors with 280 horse-power, in either car. A radiator, forming the cars' rear gunwale, cools the engines with air; exhaust tubes pierce the riveted aluminum lining. High on the side of the craft, an engine helper swung like a spider among the outrigging of one of the big air-screws, as he muffled its racket, for passenger service. Two greasy workmen, from testing seventeen gas-chambers, dropped through traps, out of the cavernous hull. A hollow voice called from the astronomical observatory sixty feet atop the hull. Below, other air-men filled gasoline tanks and stowed these in the "hold" under the decks of the cars. These indoor preparations did not suggest tinkering, in that vast interior, with its colossal tenant. The organization was so perfect, it was all over in ten minutes. Captain and pilot, in blue and gold, came over the rail. A bell rang for "visitors" to go "ashore." Gangways fell and side ports were closed.

As if a magician were pushing an Atlantic liner from port, twenty tons of aerial architecture, with passengers and crew on board, passed from the harbor. Forty men at the ropes drew the air craft forward, as tugs haul a steamer into mid-stream. Once outside, things went briskly. There was a flutter of white from the promenade deck. The crowd shouted "bon voyage" and the usual advice. A bell signalled the motors into motion. Getting under way was a revelation of air-traffic. Massive, yet lighter than air, the ship lay heavily in the gale. At the command, "los—let go," the air-men cast off. Still, the craft did not stir. Another bell started the front propellers gripping the current until they were blurs. The bow began to rise gradually, but no advance was detected. The pilot signalled for the rear propellers, which whirled at less speed than those in front. Then, with all four beating gusts along the hull, it continued rising, at a slant. There were five minutes of nothing but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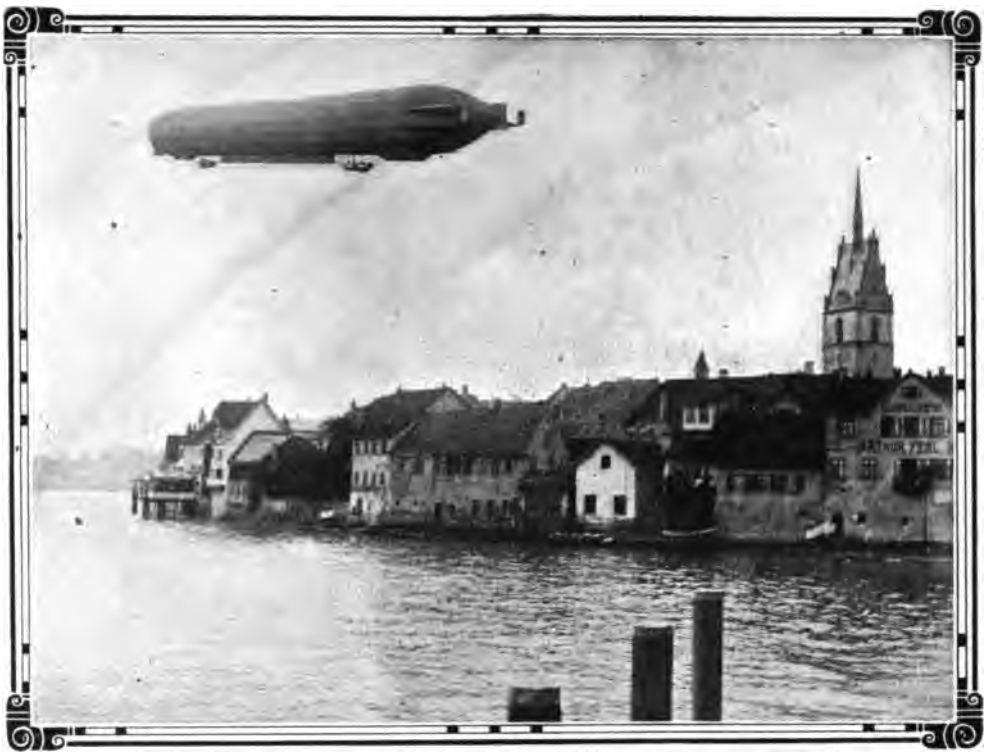
CURTISS ON HIS WAY FROM ALBANY TO NEW YORK.

Zeppelin IV BEGINNING A VOYAGE, SHOWING THE EXHAUST FROM THE MOTOR.

slipping screws. Only after the airship had moved perhaps eighty yards, did one realize that it was gliding forward as a great steamer gathers momentum. Though going with the air-drift, it rode through short gusts as easily as a liner cuts the choppy waves of the English Channel. Thus it went away nearly broadside to the spectators foreshortening the hull until that seemed perfectly motionless. Nothing indicated that the ship was quartering into the wind, except every second imperceptibly swallowed more of its mammoth proportions. Near the horizon, the airship, rising into a favorable current, grew strangely larger, as it swept across the sky at forty miles an hour.

On board the airship, the flight was more even than a steamer. There was no rising and falling as though riding waves, showing that the craft was navigating in a current. For short trips of fifty miles, like that to Mannheim, one engine was used, while going with the wind. Once, the motor was stopped and while the ship seemed to lie motionless, it was really being borne by the moving air, at ten miles an hour toward its port, under its rudders. The rudderless balloon always appears to be in a dead calm. Photographs taken from the promenade deck were as sharp as those from the motor car while running at full speed, with both engines. This remarkable steadiness is due to the rudders, propellers and steadying fins being attached directly to points where the wind presses against the hull and tries to push the craft from its course. Above, the solid hull gives a sense of perfect security. No one more than the passenger realizes that instead of making a balloon carry a car, the inventor had loaded his balloons into the craft itself. He knows that this mass of aluminum ribs, while light, is strongly braced; and that the space in its long belly completely outweighs the shell. The tremendous upward pressure of the gas reinforces the frame and makes the envelope as tough as a blown bladder. No

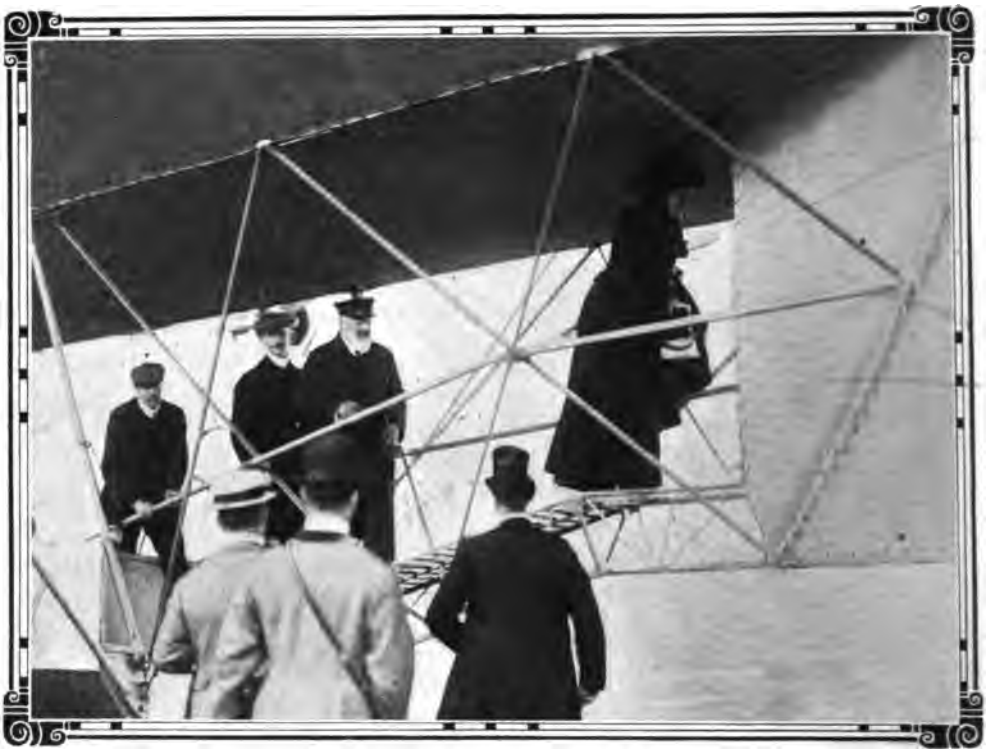
ONE OF THE NEW AERIAL HARBORS AT FRIEDRICHSHAFEN, OF STEEL AND METAL SHEETING.



THE *ZEPPELIN IV* FLYING OVER LAKE CONSTANCE.

idea of a balloon is left in the mind of the voyager. It is felt that in spite of lightness of detail, the craft is as ponderous as a real ship, and that far from being a hindrance, enormous size makes it easier to handle. Though lighter than the air in which it floats, the airship when once under way cannot be stopped suddenly by the strongest gusts. A cyclone whirling for a long time, destroys everything in its path because it is a great mass of air moving as a body. At full speed, a Zeppelin might overthrow a tower, in a collision. Of course the ship would crumple from the impact. But its big body bores through a yielding medium much easier than a small body. Precisely, because of this hugeness, it possesses a small surface and a still smaller diameter in proportion to its mass and inertia. The great weight prevents the hull from yielding more than the cars, for the reason that it is so evenly distributed over the hull.

A modern airship's momentum assists the motors in driving it, especially when the man at the controlling wheels turns the aeroplane rudders so that the air presses beneath them. On the unlucky "Z. II," which was wrecked in April, this relieved the gas from lifting more than a ton. A third motor on the "Z. III" having increased its speed to 34 miles, the planes were given a greater lifting force. Burning fuel lightens the airship and her cargo of five tons, and at the same time, the expansion of gas by the sun's heat rapidly adds to the upward force. To maintain a level flight, one set of planes are turned down and the other slightly upward, to keep the ship balanced. The air rushing on top of the planes, weights the craft. The "Z. III," weighing 19 tons at sea-level, gains a lifting capacity of 1,900 pounds over its normal buoyancy. To avert danger of bursting from expansion, her "percentage of spare buoyancy" was formerly discharged through safety valves, and lost. The greater speed and improved planes of the "Z. IV" are expected to overcome all rising; while her equal in size, the wooden "Schuette-



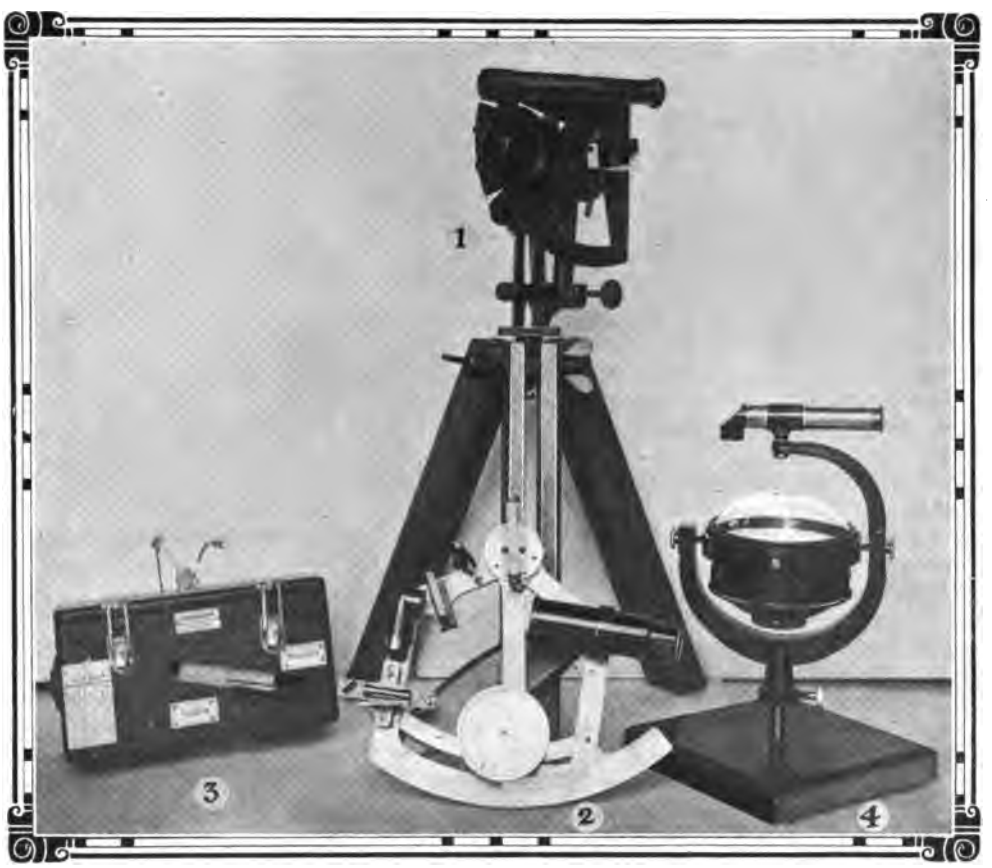
THE COUNTESS ZEPPELIN GOING UP THE FOOTWAY FROM THE FORWARD CAR TO THE CABIN SPACE.

Lanz," pumps the surplus gas into overflow tanks. But there is no further danger that modern airships will sink suddenly; they carry too much margin of gas to ever do more than gradually settle to earth, if all four of their engines should break down, a very unlikely predicament. As a Zeppelin's gas cools at night or in cloudy weather, producing a sinking tendency, water-ballast is cast and her planes driven against the air, at thirty miles an hour, make up for all lost buoyancy. The "Schuette-Lanz," which is now afloat, restores the overflow gas to her depleted supporting chambers, and casts water-ballast. Over Mannheim, when the "Z. III" was ready to descend, her pilots showed how easily they forced the great ship downward against her buoyancy. All rudders were inclined steeply toward earth and full engine power crowded on. At terrific speed the ship coasted down a long incline, against the wind. A hundred feet above the "bottom," the rudders were swiftly tilted up, instantly checking the descent. Heavy hawsers were thrown overboard from the empty cabin space beyond the forward motor car, and caught by ready hands, that drew the airliner to earth, where it lay in the open an hour, before taking other passengers and sailing for Frankfort, to which place it always returned the same afternoon.

In Germany where the entire problem of air-navigation has been reduced to the practical basis of "how great a load can your craft carry and how far can it go?" the Zeppelin airship has been accepted as the only kind that has proved anything suggesting commercial capacity. Outside of Germany, the public has been too dazed by spectacular achievements in the air to realize the significance of Zeppelin airships crossing and recrossing the empire, like railroad trains. Still less has the popular mind properly estimated the confidence of this navigator in starting for a given point with the unconcern of an automobile driver, and without waiting for fair weather. Even now, Count

Zeppelin sets a definite date for sailing in the new "Z. IV." "Z. II" and "Z. III," with ten persons aboard, were purposely driven across Germany during increasing rains, winds and even hail storms, to discover if they were unairworthy. Experimental engines broke down, experimental propellers burst and the ships even sprung leaks, as big steamers do, but the airships flew to the end of their long journeys. The "Z. II," on its maiden trip from her homeport at Friedrichshafen, arrived at Berlin minus a propeller, as the Lusitania, on her first trip, reached New York with one of her screws out of commission. The vital point in the German mind is that the ship not only *arrived,* but with only three propellers. On the way back, one of the three remaining screws burst and ploughed through the hull and one gas-cell. The ship simply came down with one-seventeenth of her lifting power gone. In two hours, the damage was repaired and she completed the trip. No other conveyance has done more. Improved engines and propellers now work perfectly and builders of all other aircraft recognize that they must not only equal but must surpass these performances, before a traveling public will accept them.

The recent stranding of the "Z. II" was one of those experiences that are rapidly making Germany the only aeritime power in the world. An airship will never again be left by ignorant operators; or started on a voyage without its navigator having complete knowledge of what the air-currents are doing—knowledge that enabled the commander of the Zeppelin's imperial consort, "Par-



AIRSHIP NAVIGATION INSTRUMENTS.

(1) Air-bubble quadrant, for establishing an artificial horizon in taking latitude and longitude; (2) Sextant; (3) Variometer automatically indicating perpetually the falling and rising of the airship; (4) Sighting compass, used for getting longitude from the sun, with tables and chronometer.

seval II," to leave Hamburg with favorable winds all the way to Cologne. Count Zeppelin's tactics have shown that had the ship gone into the air with a crew, it could have been navigated safely. Violation of navigating tactics that forbid a slack anchoring cable made it possible for a terrific gust to hurl the craft's twenty tons against a weak cable, snapping that, but permitting the ship to prove its tremendous strength by breaking away intact. Such accidents will never be repeated, as Captain Fuchs, a German, has since invented an anchor that, in a few minutes, safely moors the largest airship against the strongest winds. This anchor's steel shank has four pivotal arms that open and close like an umbrella. An earth drill bores a hole seven to ten feet deep, in which the closed anchor is inserted; the instant there is any pull the buried arms open automatically. The tests show it is impossible to tear out the anchor. In one minute, while still in the ground, the arms are separated from the shank, and all the single parts are torn out, to be joined later. Large airships will carry two anchors weighing 300 to 400 pounds, two steel cables and two earth drills.

IN THE OUT-RIGGING OF THE PROPELLER MOUNTINGS.

The exact performance of the "Z. II," on its 36-hour trip, in 1909, over mountains, from Friedrichshafen to Berlin, and back, was only recently revealed by Count Zeppelin. It gives a practical basis for estimating what modern rigid airships will accomplish with improvements and greater power. "Z. II" carried a crew of ten; food for 48 hours; 1,320 pounds of water-ballast and fuel for running two engines with 240 horse-power, for 36 hours. Count Zeppelin has explained that if his ship had started from sea-level with its full lifting power, instead of Lake Constance, a mile above sea-level, he could have carried the same crew; fuel to run both engines steadily for two days and two hours; and 1,540 pounds of ballast. This would have enabled him to travel 1,334 miles against the same winds of 10 to 15 miles an hour. Such a radius of action means that either the new "Z. IV" or the new wooden airship "Schuette-Lanz," each with 7,000 cubic meters of gas more than the "Z. II" and with 360 to 420 horse-power, could sail against the same winds, from New York to Chicago, and back without landing; or could make single flights from New York to Havana, New Orleans, Omaha, Winnipeg, North Platte, Nebraska; Salina, Kansas; Guthrie, Oklahoma; Texarkana and within almost 100 miles of Galveston. Of course, this radius would be greatly extended beyond these points if the ships were running with the wind. Present rigid ships are capable of always maintaining schedule time when running against the ordinarily prevailing winds, up to twenty miles an hour, but those who are developing navigating science, count on as many favorable as unfavorable winds, and this means that often airships will arrive a long time ahead of schedule. But to take advantage of air currents which science has shown and ballooning has confirmed, blow one above the other in exactly opposite directions, the aircraft must use the depth of the aerial ocean up to three miles. Warner Pleines, a prominent German engineer, recently said: "High speed at great heights will play an immense part in airship traffic, when regular currents have been charted and navigable ships ascend to those heights." No sane air-navigator in Germany expects successfully to navigate the air until its higher and more regular currents have been

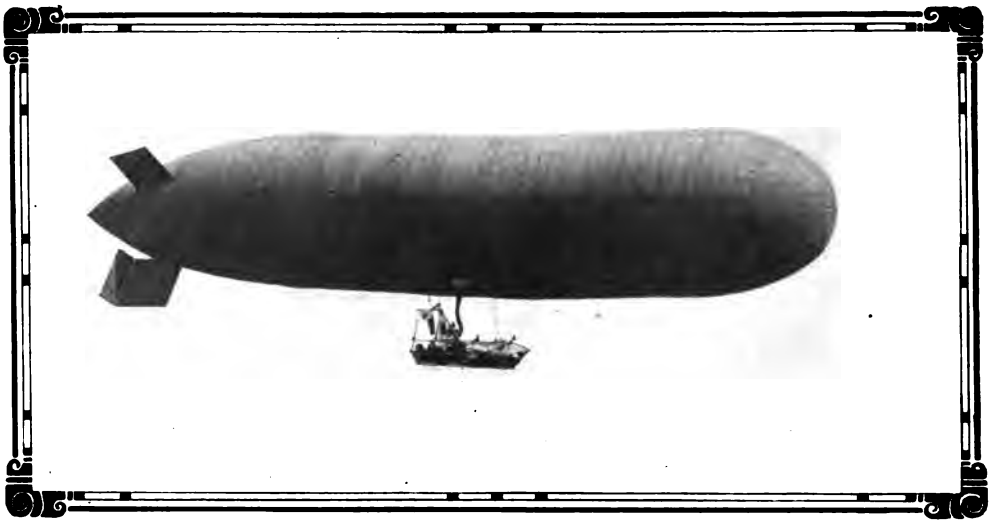
STERN OF THE *ZEPPELIN III.* SHOWING REAR CAR AND CABIN SPACE AMIDSHIPS.

thoroughly sounded and charted. This task is being undertaken by aerology, an advanced science that is gradually accomplishing what a systematic sounding of the ocean did for marine navigation.

Aerological stations at Lindenberg, Grosstebostel, Friedrichshafen, and at Aachen, Germany, are predicting winds for airship navigation. Prof. Assman, the head of that nation's chief station, is working to establish an international system of twenty European stations, nine in Germany, that will sound the upper air every hour. The Motoraeronautic Society's new station, near Berlin, sounds to the height of a mile and a half before every ascension. All this effort is steadily evolving the airship dispatching station of the future. A plan has been worked out for dividing the empire in many dispatching districts, each connected with some electric power house, and having a radius of 100 miles. At intervals these stations will send out, automatically, differently tuned wireless signals to notify the airship as it enters that radius, of its exact location, when the navigator will receive weather aerograms relayed from other stations along its intended course.

Count Zeppelin has forced the realization that none but the largest airships can compete in the world's commercial and war games, but that none but the largest ships have the lifting capacity for rising high enough to get the air current favorable to economical travel, since transportation then becomes fast and reasonably certain, and requires less motive power and consequently less fuel. England, France and Austria have turned to building large rigid airships, based on his development of aerial architecture. The British Admiralty is having Vicker Sons and Maxim build a new rigid aircruiser that must soar for days above water, and after each cruise return to its base of supplies in England, for repairs, fuel and ammunition. This radius of action requires a ship 500 feet long to give it capacity for floating a long time. The Austrian government is constructing an airship of welded steel sheeting, impermeable to atmosphere. Its designer, Lieutenant Robert von Hallborn, of the army, invented an apparatus that automatically regulates the ship's height in the air. No ballast will be carried and no gas discharged, to go up or down. This ship is expected to float for days, carrying five tons of fuel and oil, enough for a single voyage of at least 3,000 miles; its gross tonnage of forty passengers can be replaced by three tons of arms or ammunition. Maurice Mallet of Paris, is building for the French government, a rigid ship after the Zeppelin pattern.

In Germany, the airshipping industry includes six large airship yards. At Friedrichshafen, the great plant of the Zeppelin Airship Construction Company, includes airharbors, building cradles, shops and railway terminals represent-



THE *PARSEVAL III.* AT FULL SPEED, WITH RUDDER HARD TO STARBOARD.
This vessel is 226 feet long.

ing an investment of $1,000,000. Two ships can be built there at the same time. This company holds contracts for eight Zeppelins, all larger than any former ships. Two of them have been ordered by the Zeppelin Polar Expedition. They will be nearly as well equipped as an ocean liner for the new passenger airliner, "Z. IV," just completed has in addition to the salon and staterooms mentioned before, a fully provisioned café. Cooks and waiters are shipped as a regular part of the crew. The "Z. IV" is inaugurating a regular service between Dusseldorf and Mannheim, *via* Cologne; fare, $100. With twenty-five passengers, the airliner travels at a rate of nearly forty miles an hour—a speed that crowds the present aeroplanes. Still another ship announced by Count Zeppelin, will have a length of nearly 1,000 feet and a beam of ninety-eight feet, would have to be supported by 2,000,000 cubic feet of gas, and would transport 200 passengers. Professor Dietzius, of the chair of airship naval architecture in the Technical High School at Charlottenberg, designed the largest of all non-rigid aircruisers, which has been completed by the great German firm of Siemens-Schuckert, for the imperial government. As it floats in its revolving airharbor at Biesdorf, the ship is 387 feet long and carries as much gas as the first Zeppelins. It has 540 horse-power, which is expected to drive it forty miles an hour.

THE *Zeppelin* ABOUT TO ASCEND.

At Mannheim, the firm of Lanz has finished the wooden airship, "Schuette-Lanz," which was designed by Professor Schuette of Dantzic University. The craft is regarded as the greatest advance in airship building, because it regulates its gas perfectly, by automatic control.

Engineering art is also employing better textures. German factories are turning out light, durable rubber-cloth gas-cells that

leak only ten per cent of their contents in twenty-four hours. This fabric is tested and the seams coated with a patent solution and skillfully covered with narrow strips of balloon cloth. Wonderfully strong and lighter motors do not cost more than sixty per cent of their cost three years ago. Hulls are being made of paper and wood bracing, which is cheaper and proportionately lighter than aluminum. Within another year all German airships will be constructed of this material. Such ships can afford more expensive silk gas chambers that leak only four grams in a day, and save weight equal to that of four passengers. As the gas is forty per cent less expensive than two years ago, airships are being placed on a more practical basis. On the present standard of construction, Albert Wetzel has designed a wooden airship which German engineers pronounce to be the greatest advance in the art. It is 1,000 feet long and displaces 103½ tons. The hull of this colossus would weigh 36½ tons, leaving a capacity of as many tons for motors, cars, crew and ballast, and thirty tons for passengers, with a margin of 1,540 pounds for baggage. If the new Zeppelin and Schuette airships fly forty miles an hour, the Wetzel airship will easily make over forty-five miles. This is a speed that makes possible regular air-traffic and insures control of the aerial ocean on almost every day in the year.

OREGON AND THE WATER GRABBERS

By

RANDALL R. HOWARD

ABOUT twenty years ago a family settled at the mouth of Butter Creek, in Umatilla County, Oregon, and all was peace and prosperity until about six years ago. Upper settlers had then diverted so much of the water of the creek that the fields and orchard began to suffer. The courts promptly decided that the early settlers had a right to their usual flow of water. But other settlers came and the water again disappeared. There was no trouble to get a court decree with each suit, but the lawyers leeched all the profits of the farm, and the family was reduced to penury. The husband died in the midst of the water struggle. There was left to the widow the best ranch in the valley—fast returning to a desert waste—and a court-decreed water right.

One of the ranchers on the Tumalum River, near the Walla Walla district, had been using water for twenty-five years when his troubles began. He appealed to the courts to protect his water flow. While justice was still on the road, his orchard—the result of a life work—was destroyed by drought, and his land returned to its former arid condition. A humorist has suggested that it would have been much better, if instead of stealing the water, the community had merely confiscated the orchard and divided the fruit among themselves each year.

Down in southern Oregon, one of the well-known personages is "The Owner of Rogue River." He may not now be the owner of Rogue River, for the very recent new Oregon water law has brought a new epoch in the state. But until a year ago no man would think of appropriating the water of upper Rogue River without considering Dr. Ray, and the millionaire trust magnate of the East whom Mr. Ray served. As a matter of fact there was no proof that Dr. Ray

did own Rogue River; maybe it was only a matter of bluff, millions, sleek lawyers and the grandmotherish old Oregon water law. The situation was thus: A large water-power plant had been constructed at Gold Ray—a commendable act in itself. Then Dr. Ray defiantly claimed that he had appropriated the entire flow; that the river was *his*. If it could be shown that his rights controlled only nine-tenths of the flow at Gold Ray, then capitalists would have rushed over each other with their tens of thousands or millions, and would have constructed an irrigation system to reclaim some thousands of acres of land in Rogue River Valley—where orchard land recently sold for $2,300 an acre, where the Czar of Russia located his imperial orchard after inspecting the entire West, and where pears with the world-record price are grown.

JOHN H. LEWIS, STATE ENGINEER OF OREGON.
Who has aroused Oregon to conservation of its water power.

According to the old Oregon water law the only way to have tested Dr. Ray's claims to *all* of Rogue River was to actually build and complete a costly irrigation system above his dam, for the court could not presume an injury. Several moneyed men made trips from the East to look over the irrigation situation in Rogue River Valley—always deciding that their millions were safer somewhere else.

No water right in the state was so definite that it could not be threatened and contested and practically confiscated. Water lawsuits were as rattlesnakes in the rocky canyons; there was no telling when the reptiles would siz-z-z-- their warning and then send their fatal poison to the marrow before the victim could make a new track. On every stream was a barbarous maze of evident, half-evident, and hidden water rights—or fancied water rights—every one of them the basis of a possible water lawsuit.

Nothing could happen, so the Oregon Supreme Court had several times said, until after the hundred-thousand or million-dollar project had been completed and water actually diverted to the injury or fancied injury of some water-right holder. It was impossible to tell the direction from which the stab might come, for nobody knew who held water rights. The law had solemnly fixed this procedure for acquiring a water right: merely stick up a notice, near the intended point of diversion, stating the amount of water wanted and its use—and then work with "due diligence" until the water had been so utilized. The notice might have been left hanging to the barbs of a wire fence that was torn down the next week, or stuck with wooden pegs on a log that was carried away in the next freshet. One of the bright lawyers of the state has opined that "a one-armed man with a shovel" can prosecute work with due diligence. Up toward the head-waters of the Rogue River is a beautiful waterfall, that will develop 40,000 horse-power, which has been held for some years by a couple of men who take their fishing tackle—and their shovels—up there whenever they want a little outing.

The early makers of the Oregon water law did not want to be too harsh on capitalists, so they provided that if for any reason it was not convenient to hire the one-armed man with a shovel, a water right could still be held if the original filing was remade every six months. Down in California, where irrigation is an older institution, but where

water laws are still notoriously old-fashioned, valuable rights have been held by refiling for a full generation. And similar instances could be found in Washington and Montana and other states which still have as rakish water laws as had Oregon before she reformed a year ago.

The old Oregon water law said water-right notices should be filed with the county clerk, though the courts have allowed many claims that were not so filed. There was no limit to the amount of water any one man could claim. If all the water that has been seriously decreed as appropriated from the Umatilla River, up in the corner of Oregon, should come down the stream, there would be such a flood in the Northwest as never existed outside of Bible story. Enough water to submerge the Continent has been officially declared appropriated from the San Joaquin River in California. In Wallowa County, Oregon, a man naively tells us through the official county records that he intends to develop 2,500,000 horse power at a certain point on the Imnaha River, a little sheep-herder stream that a child can wade across.

An investigator of the records of five of the counties of Oregon, in 1906, found 3,400 claims for water, 628 of which were for an indefinite amount. Some wanted "all the water," others "sufficient for my needs," another "the water of this creek," and nineteen different ones claimed the entire flow of a large river.

Following the passage of the National Reclamation Act, Oregon was well to the front among the Western states that were tagging after Uncle Sam to get him to locate within their borders one of the first of the National projects. A promising site for the reclamation of 100,000 acres of land was located in Harney County. Several thousand dollars was spent by the government in preliminary work. A large reservoir was located along a stream—but how to get the water from the channel after it had been stored and released was the problem. With the snarling pack of prior-existing rights

HEAD WATERS OF AN OREGON STREAM.

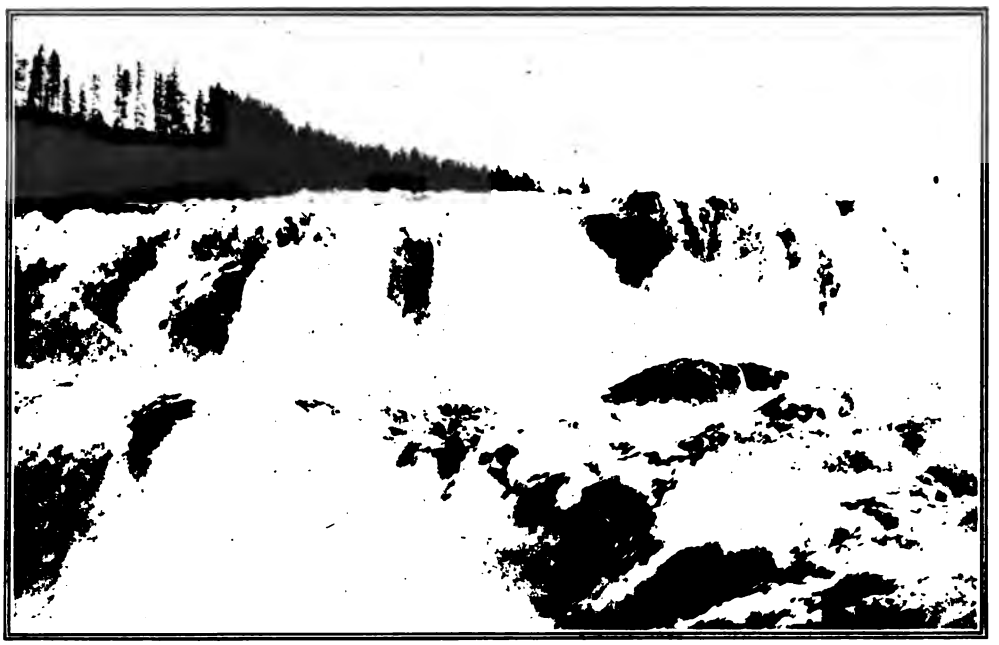
ONE OF THE MANY OREGON WATERFALLS, SHOWING THE POSSIBILITY OF A NARROW DAM THAT WOULD CREATE IMMENSE POWER.

and no official means for making water right determinations, the problem was insolvable. So the Reclamation Service moved camp and diplomatically told the breathlessly awaiting boosters that "there was a shortage of water."

The Oregon boosters scratched their heads when they found themselves losing the advertising value of several National Reclamation projects, and the free use of some government millions. They hadn't paid much attention to Oregon's water laws. They sent for the water owners, the water exploiters, and the water grabbers. These people were boosters also, and as such they granted that something ought to be done. They accordingly appointed committees and said they would pass a modern water law at the next session of the legislature. But the "modern" water law proved to be a "joker" on the part of the water speculators, and worse than the old law.

Now one of the things that the Reclamation men had talked about was a State Engineer, a man to measure and divide and look after the water of the state. They said that all of the progressive states had one, and that it was a first necessary step toward good water laws. So the legislature, as a few crumbs toward a water law, made a little appropriation to hire such a man and another little appropriation to enable the State Engineer to co-operate with the Government in water investigations. When the governor, a *Democrat,* began to look about for a man who knew something technically about the water of the State, he found the best qualified man to be John H. Lewis, a *Republican,* aged twenty-seven, and two years out of college—the two years having been spent in government water investigations in Oregon. So he made John H. Lewis State Engineer, even though he was some fifteen years younger than the next older man on the governor's staff, and nearly twenty years younger than the average age of the other officials who had to do with Oregon affairs.

It was previous to this time that the serious young government water investigator had made some resolves on his own account. He had been observing some things about the Oregon water law, or rather the lack of a water law. Some of his investigations had been conducted in the Walla Walla Valley, in northeastern Oregon. He had seen the disheartening



WILLAMETTE RUN FALLS AT OREGON CITY, OREGON.

and ruinous effects of the ceaseless litigations in the little community that was employing twenty-five lawyers to fight its water wars in the Courts.

This litigation was a feast for the water lawyers, a soul-rending period for the water users, and a nightmare for the courts. The court admitted that it didn't know what the water law was—in fact every decision changed it, and the lawyer who knew it last year was a back number this year. Certain definitely defined principles were growing up; such as, "priority of appropriation," and "beneficial use"—these two clashing with the old English doctrine of "riparian rights" which had been taken bodily from the water-soaked Island and slapped onto semi-arid Oregon. Logically applied, the doctrine of riparian rights would prevent any sort of irrigation, since it sagely says that every stream must continue undiminished in flow to the sea.

Strangely enough the subject of water was not mentioned in the Constitution when Oregon was admitted to the Union in 1859. The law-makers saw the subject of water through Eastern eyes, where the problem is one of *drainage*, not *irrigation*. The Oregon Supreme Court took the early orthodox English view when it said, in 1886, that "Running water is not susceptible of an appropriation which will justify the diversion or unreasonable detention of it."

The corporations first clearly foresaw the future value of water in Oregon. The Raley law of 1891 legalized the miner's unwritten rule concerning the posting of notices when water was claimed for use. The law further said that water for irrigation could be appropriated *only by corporations*. These corporation rights were later broadened.

In 1893 and 1895 the Oregon Legislature approved a Constitutional amendment based on the Wyoming water law, which was the first modern water law of the West and one of the present best. But the speculative corporations and big water grabbers and some of the influential newspapers didn't see any need of a new water law in Oregon, so the amendment was lost when it came to a popular vote. So water grabbing, and water scrapping, and water wasting went merrily on in Oregon.

State Engineer John H. Lewis in his quiet way turned agitator. But he soon bumped up against something. He found

ALONG THE COLUMBIA RIVER, OREGON.

out who was playing the political and the water-grabbing game in Oregon; and he felt the hand in the dark of the water interests, who, curiously enough, were satisfied with the old water laws of Oregon. Neither did the water lawyers want any change. The first thing needed was publicity—for neither water laws nor water had ever been an issue in Oregon, though water alone gives value to three-fourths of the surface of the state, and though the state is one of the richest of the nation in water-power possibilities. His first step then was to become a "knocker." And among all of the unpopular men of the boost-land of the West, the most unpopular, the most intolerable, the very black sheep and the traitor of the family, is the "knocker."

From the State Engineer's office there came forth a pamphlet, which had been "requested" by the Governor, called Special Report No. 1 on "The Need of Water Legislation in Oregon." The pamphlet brutally told just how the Oregon water laws operated, told of the community that supported twenty-five lawyers, of the ceaseless, endless, resultless litigation. The State Engineer's office had already become a sort of water-agitation publicity bureau, with the State Engineer as the man who worked up the "dope."

The State Engineer had scarcely got his letter heads printed when there came the representative of one of these promoter-irrigation projects and told the land board that his company had reclaimed 77,000 acres of land in central Oregon, and that they wanted an "O. K." to that effect. The board was for formally signing the reclamation guarantee certificate at once. But the new water law had made the State Engineer's approval also necessary—and this young official wanted more facts.

"Is the land reclaimed?" he asked.

"Sure," the company attorney replied. "Our main canal will carry more than three times as much water as is needed to irrigate the whole tract."

"But is water within reach of every forty-acre legal sub-division of the land?" he again queried.

The water attorney parried the question.

"And do you guarantee a definite amount of water per acre to each home-seeker, a large number of whom have already made water-right payments?"

"The rights of the settlers are defined in fairly plain terms in their contract with us," he replied evasively.

Then the State Engineer went to in-

vestigating, and this is what he found out. He discovered that the work of the Company was in apparent good faith—but almost criminally incomplete; that the main canal reached only to the *edge* of the tract; that much of the land was still ten miles from water; that some of it was thirty-five miles from water. Yet the company held and swore that the land was reclaimed. They privately told that if the State Engineer refused to pronounce this land reclaimed it would cost them $1,500,000, through the failure of some of their stock selling schemes. The big figures at stake seemed to have talked, for during one of the "pressure" meetings an influential politician appeared outside the closed doors and had a confidential talk with one of the board. The later meetings developed into sessions of abuse heaped upon the head of the State Engineer by the water-promoter attorneys; and they finally appealed to the governor to have him removed, and somebody appointed who *would* approve the land as reclaimed and carry out the wishes of the board themselves. Fortunately the governor refused to hear them.

CLEARING LAND FOR IRRIGATION.

All of this fight had been behind closed doors, but somehow the news floated to the winds, and column after column of facts reached the papers. A full account of the board meeting would always appear in the next daily paper. The publicity bureau was in action; the "dope" mill was working beautifully; the people were learning.

Not until about this time did the Oregon water grabbers, the don't-bother-the-water-question shouters, begin to take the water-law campaign seriously.

The commercial organizations of the state also became interested. The state engineer persuaded one of the influential members of the Portland Board of Trade to take water matter seriously, and another loyal-to-the-cause man to join the board. These two became members of a committee to investigate the water situation of the State. Their report, urging a modern water law, was adopted, which had the force of putting some of the big business men of the State into the water fight.

All of this agitation was toward the end of putting water law needs up hard before the 1907 session of the Legislature. Well, the session day came. Also came the water grabbers and water lawyers and powerful commercial interests and others who for reasons either apparent or beneath-the-surface thought that Oregon's old water law was good enough. The new water law proposed to make title to water as definite as title to land, to make the control of water dependent upon appropriation and use, to put science and sense into the distribution of water.

Naturally there must be some central authority to state water matters, and naturally this must be the work of the state engineer, for the Reclamation Service had thus recommended and he had been created for no other purpose than as State Overseer of Waters. This point furnished the cue for the men who did not want speculative control of water abolished. They said that the young State Engineer was ambitious entirely

THE SECOND STAGE IN PREPARING LAND FOR IRRIGATION.

beyond his years, that he had turned from a dreamer into a would-be Czar, with the whip-hand control of the greatest resource of the West.

And the grabbers fought as for their lives. Money began to flow. Owners of rivers and heads of great irrigation concerns were busy on the floor and in the lobby. Votes were traded, coerced, bought. Some of the legislators sold out cheap; others were more serious in their public duty and held their votes higher. One man went as low as $100, voting *against* the house bill for that sum, and then offering to vote *for* the identical senate measure when it came up later if there was forthcoming another $100. Another legislator made a speech for the bill, and then voted against it. Another received a telegram from his water-grabber home friends just in time to enable him to rush out as the clerk was calling his name on the final vote.

But to shorten the story—the bill was defeated, and the vision for better water laws for Oregon went glimmering.

About this time the Oregon conservation commission—destined to become the central organization in the renewed water fight—had become a reality, closely following the conference of governors at the White House in May, 1908. The members of the Commission, appointed by Governor Chamberlain, consisted of the following fifteen prominent Oregon men: J. N. Teal, Chairman, attorney; F. G. Young, Secretary, Professor of Economics at the State University; John H. Lewis, State Engineer; J. C. Stevens, Dist. Engineer, U. S. Geological Survey; A. T. Buxton, Master State Grange; W. R. King, member Oregon Supreme Court; J. N. Hart, attorney and State Senator; F. J. Miller, capitalist; C. B. Watson, attorney; J. R. Wilson, President Portland Academy; R. S. Bean, Federal Judge; C. S. Jackson, publisher; E. R. Lake, Professor of Botany at the State Agricultural College; R. W. Montague, attorney; W. K. Newell, President of State Horticultural Society.

It was early evident that the Oregon Conservation Commission considered water laws the most imperative need of the State. In their initial report they devoted ninety-nine pages to water, as against twenty-three pages devoted to all of the remaining resources of the State. This pamphlet retold the brutal facts about the lack of any semblance of secure water titles and the ceaseless litigation and the hampering of State development The Commission announced that it would make a study of the State water situ-

ation. They advertised a public meeting to be held in Portland on a certain day, when arguments for and against the old water laws and the proposed new water law, defeated at the last session of the Legislature, would be heard and discussed.

The day for the meeting came, and the water grabbers and their friends flocked in dozens and scores bringing with them their best mouthpieces and their loudest arguments. But surprise upon surprise! Somebody else had been packing the meeting also. The Conservation Commission had not stopped with southern California; they had sent to Wyoming, even to Washington, D. C., for advocates of their policy. Above all, who was the strange man in the chair! The *advertised* chairman of meeting was none other than the State Engineer, whom the water-grabber people thought it would be a lark to walk all over. The strange man in the chair was one of the best-known lawyers of the state, a membert of the Oregon Supreme Court, and one of the most recent converts to modern water-law principles, hence fresh and full of the best arguments.

The meeting lasted all day. The papers spoke of it as a great victory for the advocates of the new water laws, and then followed up the meeting with favorable editorials.

Another step in the water fight was to bring together in the state, and within

YOUNG'S RIVER FALLS, NEAR ASTORIA, OREGON.

IRRIGATION DITCH AND FLUME IN CENTRAL OREGON.

hearing of the newspaper men, the best-known advocates of the two most modern though somewhat opposing water systems that are applied in Wyoming and Idaho. Through the conservation commission the expenses of prominent water experts were paid from all parts of the United States—men big enough to merit a couple of columns in the newspapers, and men who could call down the old Oregon water laws with a zest. The water question became *the* recognized political and economic issue in the state. The Lewis lecture-publicity-agitation bureau and the Oregon Conservation Commission had aroused the people to such a point that the tide became a storm wave. And it was the natural thing that the new water law was passed by the 1909 session of the Legislature, though the opponents made a terrific fight and held off the final vote until the last day of the session. The model water law would have been lost even then but for the fact that the Legislature was afraid of the people, for the water law would have been referred to them under the initiative and referendum—"Oregon's Big Stick"—and would have been overwhelmingly passed over their heads to the eternal discredit of the lawmakers.

The reformers took advantage of the public clamor and made their water law as nearly model as possible. In fact they are said to have taken several big steps in advance of any other state water code. One of these steps was to limit water power franchises to a period of forty years—instead of granting them for eternity as under the old water law and as is the general practice in the United States. Also a very simple and inexpensive method for classifying and protecting existing water rights was enacted.

Still another model water law was drawn from the sleeve of the State Engineer and passed while the water enthusiasm was at flood tide. This law repealed the old Carey Act law which had made the state a party to wild-cat waterless water-right promotions, and which had been the means of practicing many frauds upon settlers—for example, the sale of State-guaranteed water rights to 275 settlers on Tumalow Creek, when there wasn't enough water in the creek for thirty-five irrigators. This new Carey Act law establishes strict supervision over Carey Act projects, giving protection both to honest capitalists and homeseekers.

Likewise a supplementary water law, passed at the same session, places an annual tax upon all water power to be developed in the future.

The new Oregon water law has been in force more than a year, and note the changes. Water titles will become as permanent and definite as land titles, with the completion of the measurement and adjudication of the streams of the state. Already all water rights have been settled on three important streams—whereas under the old law there could be fighting and litigation till Doom's Day without definitely settling anything. On one of the streams, Willow Creek in Morrow and Gilliam counties, the total cost of the adjudication was but an average of eight dollars for the 286 parties to the suit. The lands irrigated by sixteen other streams have been surveyed and are in the process of adjudication. The right to water is based upon beneficial use. If the water is not used within a limited time it reverts to the state or the applicant next in rotation.

All new applications for the use of water must be filed with the State Engineer where they are indexed in convenient form and open to public inspection. Up to May, 1910, more than 600 new applications for the use of water had been filed. The theft of water is now a crime in Oregon, and the law provides for the appointment of water masters who will see that water henceforth goes to those to whom it belongs. Under the "safety and welfare" clause of the law, the State Board of Control decides whether water is more valuable for irrigation or for power, and makes contracts accordingly. The clause limiting water power franchises to forty years also works to the same end.

Water waste is checked. No person can hold more water than he can beneficially use. Up in the Walla Walla Valley section, where a flow of a cubic foot (seven and one-half gallons) per second through 100 days often creates from $10,000 to $20,000 worth of fruit, some people under the old law covered their land to a depth of twenty-two feet during the season, and the average depth

ONE OF THE MANY USES OF WATER.
Tearing down a hill by hydraulic power.

was about seven feet—when two feet, and often one foot, in depth will insure good crops. Also an excessive use of water nearly always injures the crop and washes away the soil.

The Oregon water law assumes its authority from the right of the state to maintain peace and order and to protect property through police power. Such state authority is happily discovered, for if such a water law must be based upon a constitutional amendment, vested and established rights might be exempt and the force of the law partially lost.

There is a final and most conclusive test as to the need and practicability of the new Oregon water law. The law determines early rights, protects existing rights, but most of all it encourages new rights. Water is no longer for barter and speculation and the creation of lawsuits—*it is for use.* For five years prior to the passage of the new water law no new Carey Act projects were initiated in the State, and with one possible exception all of the former projects were more or less failures.

In a single year, under the new water law, there have been initiated nine Carey Act projects that will reclaim at least 600,000 acres of land—an area almost one-half as large as Delaware. The total cost of these new projects will be about $50,000,000—as contrasted with $8,000,000, the estimated total cost of all previous irrigation works in Oregon, including the two government reclamation projects. One of the projects will reclaim 200,000 acres along the John Days River at a cost of $15,000,000. This project was abandoned by the Government because of lack of funds. The land covered by the John Days project at present is worth about five dollars an acre; when irrigated it will be worth at least $300 an acre. The other Oregon Carey Act projects are as follows: Powder Valley, Baker County, 60,000 acres; Jordan Valley, Malheur County, 60,000 acres; near Vale, Malheur County, 15,000 acres; Warner Valley, Lake County, 145,000 acres; Eagle Valley, Baker County, 30,000 acres; Pine Valley, Baker County, 10,000 acres; Silver Creek, Harney County, 20,000 acres; Blixen River, Harney County, 30,000 acres; Tumalow Creek, Crook County, 30,000 acres.

Water is Oregon's greatest resource, yet until a year ago it was the most carelessly treated. There are those who say that as water becomes more and more valuable it should be made to return a small part of its annual value to the whole people—since in that day all will pay water tribute through power charges for heat, light, traffic and manufacture, and for the products of irrigation. Practical men say they expect to see the time in Oregon when the public income from water will meet all the expenses of the state government.

MARKET DAY IN CHICAGO'S GHETTO.
Fruits, fish, meats and other articles of diet are freely exposed to the swarms of flies that here abound.

CAMPAIGNING AGAINST THE FLY

By

GEORGE P. CHENEY

CLEANLINESS is cheaper than sickness. Once the people of the land learn to profit by the fact, there will be, among other pleasant changes, fewer flies. Many communities are endeavoring in more or less thorough fashion, to act upon the principle, and some have made up their minds to an unqualified enforcement of it. Among these is the village of Oak Park, lying just beyond the city limits of Chicago.

The fly problem is simple as unwinding a spool of thread: filth, flies, disease. No filth or rubbish, no flies; no flies, fewer cases of typhoid fever, tuberculosis, and the many intestinal maladies that children fall prey to. Between the widely spread bacteria that find lodging in garbage cans, barn refuse and alley rubbish, and human beings to whose systems the germs are eager to be transplanted, the fly often is the connecting link. The fly is the common carrier of disease, and wings its way with fateful buzz in a world where the problem of distribution is as important as in industry.

From the moment the fly emerges, full grown, from the shell and crawls to the sunlight to dry at the top of the heap of refuse in which it has come to life, it becomes the messenger of pestilence and death. It retains its love for the filth in which alone it is propagated, and develops a great fondness for the dwellings of man. It circulates between the two.

When Oak Park took thought in the spring to be a flyless town, it found the task of twofold nature: prevent the breeding of flies and keep them from houses. Of these the primary and greater problem is the prevention of breeding. Simple on its face, this is an undertaking with so many phases and calling for the tireless coöperation of so many persons—particularly of persons who ordinarily scoff at scientific efforts at sanitation and cling to unreasoning customs—that it is worthy any city's mettle.

The simple fact is, as studies in all parts of the world have shown scores of times, that fully ninety per cent of all the house flies are bred in horse manure. The remaining ten per cent come from other stable refuse, from garbage, from rubbish left by the roadside, in vacant grounds and in alleys and from old closets. Contrary to common belief, trees, shrubbery and gardens are not fly producers. The eggs of the female fly, deposited in the congenial filth, run the course of development in about ten days when full grown insects emerge,

A Florida View of the Fly.
From the Pensacola Journal.

The Warfare in Kansas.
From the Wichita Beacon.

after having fed during the transformation on the decaying matter by which they are surrounded.

The stables, then, are the first point for attack. Acting on the best advices and having in mind the extensive experiments made by the Bureau of Entomology of the United States Department of Agriculture, Dr. Albert F. Storke, Oak Park's health commissioner, gave as his first instruction that all barn refuse must be screened, or put in tight boxes. This has been found by L. O. Howard, government entomologist, by men of the Chicago health department, and by many others, to be the only practicable way of keeping flies from breeding in the refuse. Mr. Howard tried chloride of lime, mixed in the refuse day by day, and it killed the fly maggots when the experiment was tried on a small scale. However, the expense of the chemical and necessity of careful attention day by day made its use of no real value for actual practice. Kerosene was used with even better results, but with the same objections.

The tight boxes and screens were found the only usable plans. But that is only the first step. As flies come to maturity from eggs in ten days, the refuse should be removed at least once a week, as a final precaution. When scattered on the ground the manure dries

soon and loses its attractiveness for use as a fly conservatory.

Dr. Storke, in Oak Park, gave instructions to the police of the village to see that his order as to stables was obeyed. This was supplemented by a reminder from Welland F. Sargent, commissioner of public works of the village, that the ordinances forbade the littering of alleys. The police are told to watch for any trash or rubbish thrown into alleys, report the offenders and warn them not to repeat the violation. The police also are to use their noses and eyes in a search for unclean garbage cans. The village has its own garbage crematory. Nothing gets past that.

With these regulations enforced the Oak Park people have reason to believe few flies will be born in their town. They then can begin the other part of the campaign, keeping the pests out of houses, away from food in grocery stores, bakeries and candy shops. Screens are of prime necessity while any flies or mosquitoes remain to bother the habitations of men. In many places renters have been advised to insist upon the proper screening of houses as rigidly as on good plumbing.

"Kill the first fly," was the Oak Park injunction early in the season, and it is supplemented by the suggestion that the second, the third and so on to the end of the list get the same treatment. Considering that one female fly can bring into being several millions of the pest in one summer, it would seem a good job to kill that first one.

If the first and its immediate followers are let live and the house becomes overrun, there are several suggestions for ridding the rooms of them. One course, taken from the south where mosquitoes are a public menace, is to burn pyrethrum powder in a room. This benumbs the flies and they fall to the floor and can be swept out. The trouble with this is that pyrethrum powder is not sold at many drug stores in the North.

From the American Civic Association at Washington comes this hint: Drop twenty drops of carbolic acid on a hot iron; the vapor kills the flies. Sticky fly paper has both good and bad qualities. It does trap some flies. But those that get their feet coated with the adhesive

A TERROR OF THE NORTH.
From the St. Paul Dispatch.

matter are likely to return to their filth heaps prepared to carry back to the house added quantities of disease-bearing matter sticking to their feet. Fly traps do their part but Dr. C. St. Clair Drake of the Chicago health department says the insects are cautious.

"The flies soon learn to be wary of traps," Dr. Drake says. "Those that have had any experience with them cannot be caught, and shortly a tribe of flies too shrewd to be trapped might be evolved. The insects also avoid the sticky fly paper after one experience. They are crafty little fellows and the instinct of life is as strong as in many superior beings."

Various poisons are suggested, the best of which, the doctors say, is formalin in water. Put a spoonful of the chemical into half a cup of water and leave it exposed in the room and the flies will do the rest.

In passing, it is worthy of note that this insect, with its love for odors that offend the nostrils of man, has a strong aversion for scents which the human likes. This has given a hint for still another prevention, of minor worth. Aromatic plants in rooms and at windows act as repulsives. Such plants, then, have a double value in sick rooms: they

are pleasing to the sufferer and discourage the fly that, with evil purpose, looks through the open window.

Oak Park's hopes for the elimination of flies are the greater because of the character of the residents of the village.

"We think our people are of exceptional intelligence," says Dr. Storke, "and that the health officer's efforts will appeal to practically everybody. The village has no plague spots, no tenements, but an abundance of pleasant homes, with well kept lawns and gardens. There are fewer horses in town than some years ago—they have gone before the automobile."

It is recalled that when the Oak Park folk set about to give a horse show last fall, the association that had had charge of such affairs in previous years, took count of the equestrian stock of its directors. Only one was the owner of a horse. That one still held title to a superannuated family steed that had done service in the old surrey "when the children were young" and was pensioned off on a farm. The Horse Show Association gave the show, nevertheless, and the guests came in automobiles.

What started Oak Park on its anti-fly campaign? The working of public sentiment that the village ought to be the first to achieve the distinction of ridding itself of the pest. That is about all the explanation that can be given. Dr. Storke says typhoid—the bacteria of which the fly disseminates with fatal effect in so many cases—has been practically an unknown visitor in the town for nearly two years.

"The last appearance of typhoid in any form that might be considered as approaching to an epidemic," Dr. Storke says, "was when twenty-five cases appeared almost simultaneously in twenty-two households in the northern part of

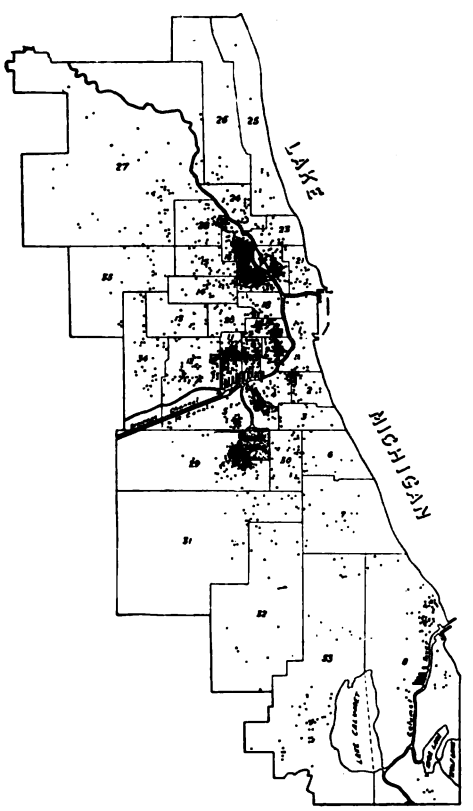
ANOTHER GHETTO SCENE.

A glance at the map on the opposite page shows the awful effects of thus exposing food to flies.

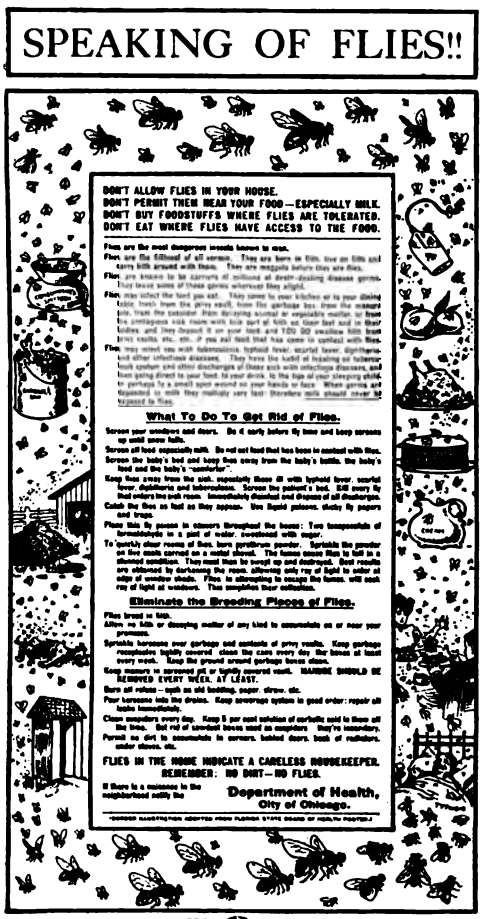
town. Representatives from the state board of health and from the Chicago board came to see us and to investigate. The state board men could see nothing but water. But the whole town used the same water and the typhoid was confined to those twenty-two houses. The Chicago men were certain it was flies. That looked more reasonable, but I was unable to find the source of the infection.

"I inquired in each household and found nineteen of the families bought their groceries at the same store, one of the best in town. And grocery stores are protected from infection by flies far better than when I was a boy. Then, the crackers, cheese, sugar and other eatables were kept in open boxes and barrels over which flies swarmed at will. Now almost everything except fruit and vegetables comes in sealed packages.

"As I say, nineteen of these families patronized one store. Eighteen of these



WHERE CHICAGO'S BABIES DIED FROM DIARRHEAL DISEASES DURING THE SUMMER OF 1909.
Each spot,—a total of 1,570.—represents a death.


SPEAKING OF FLIES!!
DON'T ALLOW FLIES IN YOUR HOUSE.
DON'T PERMIT THEM NEAR YOUR FOOD—ESPECIALLY MILK.
DON'T BUY FOODSTUFFS WHERE FLIES ARE TOLERATED.
DON'T EAT WHERE FLIES HAVE ACCESS TO THE FOOD.
What To Do To Get Rid of Flies.
Eliminate the Breeding Places of Flies.
FLIES IN THE HOUSE INDICATE A CARELESS HOUSEKEEPER.
REMEMBER: NO DIRT—NO FLIES.
Department of Health,
City of Chicago.

A POSTER ISSUED BY THE BOARD OF HEALTH OF CHICAGO.

families bought celery some two weeks before typhoid appeared. This celery, the grocer's books showed, came from a South Water Street commission merchant who, in turn traced it back to Kalamazoo, Michigan. Thinking of the method of raising celery, enriched by manure of any kind available, and thinking of the fact it is eaten uncooked, I made inquiry at Kalamazoo whether typhoid was prevalent there. A negative reply was received, but shortly afterward the medical journals reported the disease had been epidemic.

"Go back one step farther. How many flies were breeding and feeding in those celery fields in Michigan? How large a part did the flies play in spreading the epidemic there? Any one can guess the answers."

In Oak Park, with a small community well housed, with plenty of room around residences and intelligent folk within them, the warfare on flies is a simple matter compared with that in a large city. And, as in Oak Park the campaign is largely one of education, of impressing on the people the fact that flies are more deadly than the jungle beasts and serpents of India, so it is in the large city.

The Chicago health department prepares, regularly, maps showing the prevalence of various diseases in the city. One such map indicating deaths from diarrheal and other intestinal maladies among children and from typhoid fever might properly be called a fly map of the city. In appearance it is a skeleton of the outlines of the city's boundaries, on which in several clusters, are perfect blotches of fly specks. Each speck means a knot of ribbon at some door where the fly, not understood and not feared, was permitted to enter and set his fatal footsteps on food, or was let take a turn at baby's bottle.

From the fly's habits and from the habits of children, the insect's greatest ravages are among the young. The maladies that take the lives of thousands with the passing of every summer have been blamed for untold centuries on the hot weather. Hot weather breeds flies rapidly; that is the connection.

With this flyspeck map of the city as a working basis, the health department is sending into each district so marked its very best inspectors, men who have records for efficiency in other sections. Behind them go policemen, specially trained and instructed, and the procession ends with street cleaners. This life saving crew is seeking to protect those who do not know how, or will not take the necessary precautions, to wage war, on their own account, on disease; who do not appreciate that cleanliness is cheaper than sickness.

KEROSENING BAD FISH IN CHICAGO'S FLY-BREEDING DISTRICT.
If the stench of putrescent flesh will not deter purchasers, the odor of "coal oil" will.

With the coöperation of the settlement houses and the charitable organizations the health department is carrying on a publicity campaign in the congested districts. Speakers in every tongue heard in polyglot Chicago tell night after night the story of the death carrying fly. For variety, some of the lectures are delivered from phonographs.

A decidedly striking feature of the warfare on flies is being directed by a philanthropic organization in the East. A series of moving picture films have been prepared in Germany showing the life and habits of the fly. The American rights to the pictures have been bought by the organization, which offers them to the five and ten cent theaters at a nominal cost. These pictures will tell more vividly, perhaps, than anything else could, what a vile and altogether dangerous little beast the fly is.

THE BAKER'S GOODS DO NOT ESCAPE FLY INFECTION.

In the pictures, however, the flies are not so small. They appear as marvelous creatures, with transparent wings, great hairy legs and strange eyes with wonderful range of vision. These creatures are shown hatching from eggs, are shown in the maggot stage in the refuse heaps, feeding in the house and winging their fateful way on from contagion center to food and to sleeping children.

Chicago has some special fly breeding spots that it still maintains, in deference to old custom. These are the city dumps, half a dozen or so in number, which give the lie to the statement that this is the twentieth century and the land of enlightenment. Yes, Chicago has its dumps yet, where flies are free to go and deposit their eggs, to bring forth other flies and keep the circle complete. Be it said, however, so much of the refuse deposited in these places as can be burned, is burned. But the nuisance and the peril still persist to a degree.

Vacant lots are another prominent evil in Chicago. Dr. Drake tells of seeing the street cleaners of the West Park system empty sweepings on such a tract. The refuse made an ideal breeding place for flies, he said. Fortunately there is not room in a large city, as a rule, for much accumulation of refuse at the stables where horses are kept. It is true, however, that few give thought to removing the manure once a week, which should be the utmost limit for leaving it, if flies are to be kept down. Also little or nothing has been done in the way of requiring the screening of bins in which this refuse is thrown.

The anti-fly fight of Chicago and Oak Park is, to a degree, the fight of the nation. Every aggressive state board of health has sounded the alarm and many cities have joined in the campaign. The Illinois board has made investigations which have added to the knowledge of the dangerous character of the insect. Indiana has put out a model ordinance for cities, with provisions forbidding the leaving of refuse in alleys and vacant lots, and requiring the screening of food exposed in stores.

Florida has cautioned the people of the state that the warm southern air bears an enemy more to be dreaded than any crawling thing of the swamps. Kansas has sent out a bulletin with the pointed admonition "Swat the Fly." This bulletin pictures the entire domestic army of defense—housewife, watchdog, and son—engaged in deadly combat with a huge insect which strives to enter the door.

Among the cities which have been conspicuous for their warfare upon flies, New York is given first rank. The Merchants' Association had an exhaustive investigation made of the diseases scattered in the foot prints and flyspecks

of the insects, and the number of deaths attributed to the pest was astonishing. Rochester, New York, which has a very alert health department, has done good work, and Detroit has attracted attention.

And will flies disappear, then, in a few years? asks the hopeful citizen. No. No one who has studied them believes so for a moment. They can be eliminated largely from cities, where screens would become superfluous were warfare upon the insects waged unitedly and intelligently. But the day when they shall vanish from the farms is beyond human vision. And the farms will remain constant feeders of the cities; hence the cities never can relax their vigilance and call their task done.

No one can say with certainty what the maximum life of a fly is, but there is very good reason for believing it exceeds a year. With the first warm days of spring, flies appear mysteriously in houses. There has not been enough warmth outdoors for eggs to have hatched. The flies, scientists believe, have been hibernating in crevices and various hiding places within the house.

The eggs, also, retain their vitality through the winter. The nature of the matter in which they are deposited facilitates this. Eggs deposited just below the surface late in the summer may lie there dormant, owing to the chill weather, until they are buried deep in the day-by-day accumulations that later protect them from the severest of winter's frosts. It still is a question, moreover, whether frost destroys the life spark. As the heap warms under the rays of the early summer sun, the hatching process begins and the insects work their way betimes to the light, to find the world awaiting conquest.

Another phase of the dissemination of flies from farmyard to city house is the action of the wind. Some men say a fly seldom travels more than a few hundred feet from the spot where it hatched. That might be the case, were it not for the wind. Malaria has been traced in the path of a strong wind that has carried mosquitoes hundreds of miles from the community where the disease was prevalent. The mosquitoes rode the gale, alighting here and there to start fresh cultures. A high wind, similarly, will bear flies long distances, permitting the dissemination of disease under most mysterious conditions.

Imagination

We figure to ourselves
The thing we like; and then we build it up,
As chance will have it, on the rock or sand,—
For thought is tired of wandering o'er the world,
And homebound fancy runs her back ashore.

—Sir Henry Taylor.

FARM HOMES FOR THE CITY HOMELESS

By

F. G. MOORHEAD

SINCE Society cannot reduce the number of bread and meat eaters, Governor Herbert S. Hadley of Missouri believes society must do whatever it can to increase the number of bread and meat producers. Nor does he consider the task an impossible one. He has set the wheels in motion to solve the most vexatious problem of the day: to divert the people from the city to the country and to make barren land yield up the fruits of Nature in order that millions, who are now starving or do not know where the next meal is to come from, may be fed three times a day.

"It is generally recognized among business men," asserts Governor Hadley, "that the present high cost of living is directly traceable to the fact that production has not kept pace with consumption." He proposes to be a "show me" executive in every sense of the word and already he has brought about the organization of the National Farm Homes Association, the object of which is to furnish farm homes to the city homeless.

The scheme is simple. The governor has discovered that great tracts of land are available in Missouri, Arkansas, Alabama, Mississippi, Louisiana, Texas, and other southern states at $10 an acre. He proposes to secure this land—a few thousand acres to begin with and great tracts eventually—and parcel it out to the homeless of today at the rate of forty acres to the family, thirty-two of these 40-acre farms to cluster around a central farm of 160 acres, where a skillful agriculturist shall teach the colonists how to farm economically and profitably. The cost to the settler for his chance to leave the overcrowded city and get his first real chance in life will be as follows:

Land, 40 acres at $10 an acre..	$ 400.00
Buildings and fences.....	400.00
Stock and teams.....	300.00
Implements, etc.	100.00
Total	$1,200.00

But, it is contended, the crying need is for farm homes for the homeless who are moneyless as well. It is this identical class of people which Governor Hadley proposes to secure. But not all who come are eligible. Millions may apply but only thousands can be accepted. So he proposes that all applicants for farms shall be subjected to examination by a board of the association, care to be taken to aid the deserving poor who want to get the land and to differentiate between them and the hopeless derelicts.

JOHN H. CURRAN.
Immigration Commissioner of Missouri and Governor Hadley's chief lieutenant in his colonization scheme.

Having satisfied the examining board that they are earnest in their ef-

BETTER THAN RUNNING WILD OVER CITY PAVEMENTS.

forts to get to the country and willing to learn, even if by their own showing they know absolutely nothing of farming, it is proposed to give them, without any advance payment, one of these 40-acre farms, fence it, erect a comfortable house and commodious barn and equip the place with the necessary implements and live stock. The first year the settler will be exempt from payment or taxation. Thereafter he will pay back his original loan in ten annual installments of ten per cent each, together with interest and taxes. Governor Hadley has figured it out carefully and he believes this will be easy to do. He computes the possibilities of a 40-acre farm to be as follows: Three acres of tomatoes, net average, $150; one and one-half acres onions, net average, $150; two acres potatoes, net average, $100; four acres fruit, net average, $400; one acre small fruits and berries, $150; four acres corn and cowpeas, $160; four acres ensilage and late rye, $200; eight acres alfalfa, $240; four acres timber, $25; three and one-half acres miscellaneous, $200; four acres clover, $100; cows, pigs, chickens, ducks, etc., $500. Total, $2,375. Figuring extra cost of living, extra labor, annual payment, etc., at $1,375, leaves a net balance of $1,000 a year for the farmer. To this may be added his house rent, his fuel, which is on the ground, and a great deal of material, such as fence posts, etc. Thus it may be seen that since the yearly payments cannot exceed $160, inclusive of interest, the final payments will be easily met, and that without any great hardship.

But how can the unskilled city man learn, other than by costly experience, how to make his acres yield so plenteously? Here is where the central instruction-farm comes in. Governor Hadley outlines his idea as follows:

MOWING IS A RARE TREAT TO THE CITYBRED LAD.

"There should be a large central farm, owned by the association and directed by the same. On this central farm there will be employed some of the larger machinery, such as ensilage and feed cutters, seed fans, manure spreaders, etc., which at intervals can be utilized for the small 40-acre tracts surrounding the larger farm. On this farm also should be placed the creamery, cannery, sawmill, and other equipment necessary for caring for and preparing for market the products of the individual farmer. The director of this farm should be a trained agriculturist, who will assist the individual farmers to plan their farms, locating the fields and the buildings, designating proper crops, also adopting the plans for crop rotations.

"The settlers will have at first hand daily suggestions and at all times all the guidance necessary to make them, within a couple of years, better intensive farmers than many who have lived on the farm all their lives. These people also will meet together frequently to confer with each other and to receive instruction from the head agriculturist and his assistants with reference to crops which must be planted in the near future. Without expanding this method further, it will be readily seen that under such direction these colonists can probably pay back to the association their total indebtedness for farm and equipment much more quickly than the average colonist cancels his partial indebtedness.

"Again, remember, that the presence of facilities for caring for and manufacturing dairy and fruit and other products of the farm will also add value to the crops and give these colonists a strategic position in the markets.

"The head of the central farm will, in co-operation with representatives of the individual farmers, attend to the marketing of all products, taking advantage of all factors that will favor them.

"By this arrangement of the 40-acre farms around a central farm, opportunities can be given for mutual intercourse and amusement that will lessen the monotony that the settlers might experience in the change from city to country life. The instruction that will be given at gatherings of the farmers, in agriculture, horticulture, dairying and stockraising, will cause an interchange of ideas gathered from their personal experience."

All of this, and more, too, the governor worked out in advance of any public conference on the subject, having the assistance of two men as devoted to the interests of the city homeless as himself: John H. Curran, chief immigration commissioner of Missouri, and Prof. Frederick D. Tucker, former director of the

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GOV. HERBERT S. HADLEY OF MISSOURI.
Originator of the "homes for the homeless" movement. He is striving to send more people to the farms.

STACKING AND RAKING HAY BY MECHANICAL DEVICE.

University of Minnesota Agricultural college. When these three men believed they had arranged enough of the details to show how practical the plan was they called a public meeting, which was held in St. Louis in May. This meeting was attended by forty or fifty sociological workers from all over the country, while letters of approval and of promised interest or co-operation were received from Dr. Lyman Abbot, of the Outlook; John D. Archbold, of Standard Oil; Miss Sophie B. Wright, of New Orleans; Senator Dolliver, of Iowa; Secretary Nagel, of the Department of Commerce and Labor; Governor Hughes, of New York; Governor Willson, of Kentucky, and others. The secretary of the Ontario-Canadian Parliament sent a telegram of inquiry for more details, saying that the parliament was deeply interested in the project. Talks were made by Governor Hadley, Mr. Curran, Prof. Tucker, Archbishop Glennon of the Roman Catholic church, Rabbi Harrison, Carl R. Gray, first vice president of the Frisco railroad, and others, and before the meeting adjourned the National Farm Homes Association was organized. Governor Hadley had "shown" the others.

The rest of the present year will be devoted to getting the public aroused to the plan, securing options on land and interesting men and women with money. It is not proposed to make the settlers objects of charity. They will pay, in time, for everything they have been given. Nor is it considered necessary to raise a large amount of money to start the colonizing. One gift of $50,000 is already semi-officially announced. This will be sufficient to establish one colony unit, figuring that a single 40-acre farm costs

A WELCOME CHANGE TO THE POOR CITY FAMILY, ONLY A LITTLE WAY REMOVED FROM THE BREAD LINE.

$1,200, making $38,400 for the thirty-two, and allowing $11,600 for the 160-acre central, instruction farm. But the prospects do not stop with this. Several owners of immense tracts in Southern states have taken the matter up with Governor Hadley and propose donating alternate quarter sections for colonizing purposes, believing that the rapid settlement of the land and the profitable returns therefrom will cause such a demand for the other sections, which they retain, that they will be able to sell them for enough to offset the original land gift.

The first and trial colony will undoubtedly be established in Missouri next spring and after that other colonies are expected in other states within a short time. "I am surprised at the tremendous interest shown in the movement," says Governor Hadley. "It shows the great need for some such organization as we have launched and the big possibilities that are wrapped up in its successful operation. I see a new commonwealth within the various commonwealths of our nation where the tilling of the soil and the caring for the products thereof by all the members of these communities shall be directed with intelligence achieved by permanent co-operation whereby all the forces of Nature and Humanity which make for the highest welfare of society have been utilized.

"The establishment of farm homes under the direction of this association can, with proper support, be carried on over a wide area and their influence will be felt throughout the land. They will add great strength to the nation, not alone in the material contribution which is necessary for growth and development, but also in the expansion of the spirit on the part of those who will support this noble enterprise and on the part of those who take advantage of the great opportunities it offers.

"They will contribute a new type of citizenship, which will be the best crop these farms will produce."

PELLAGRA CAUSED BY GNAT?

By

RENÉ BACHE

PELLAGRA carried by an insect!

It is one of the most important of recent scientific discoveries that is announced by Dr. L. W. Sambon, lecturer at the London School of Tropical Diseases, and member of the "field committee" which is now engaged in making a study of pellagra in Italy.

Dr. Sambon, it will be remembered, is the man who helped so importantly to prove the case against the malaria mosquito by his classical experiments in the Roman Campagna, where he, with one companion, spent several weeks in a screened hut on the marshes, merely taking the precaution not to go out at night. Inasmuch as the malaria-carrying mosquitoes fly only at night, they suffered not at all, though dwelling in one of the worst known breeding places of the abominable insects.

Accordingly, authority of the highest kind attaches to Dr. Sambon's announcement that pellagra in Italy owes its distribution to a midge, or black fly, nearly related to our own "buffalo gnat." Just as malaria could not exist without the Anopheles mosquito, so likewise does pellagra—a much more terrible disease, resembling leprosy—depend upon this black fly for its transmission and dissemination among mankind.

Such being the case, it will be asked, how does it happen that this dreadful malady, unknown until recently in the United States, has suddenly broken out

COURTESY U. S. PUBLIC HEALTH SERVICE.

AN UNEVEN DISTRIBUTION OF DISEASE.
The skin on the right hand is much cracked and discolored; the left hand is less seriously affected.

in many parts of our own country, spreading with alarming rapidity, and threatening to become a plague?

The reason why—it is supposed—is that the Italians, who have been swarming into this country in such multitudes within the last ten years, have brought the disease with them from Italy, where it has long been rife. They have *infected our buffalo gnats,* which, thereupon biting healthy persons, have communicated the malady to them. It is just like the case of the mosquito, which, having sucked the blood of a malaria sufferer, attacks somebody else and introduces the malaria germ into the latter's blood.

WORM-LIKE PARASITES IN THE BLOOD THAT CAUSE SLEEPING SICKNESS.
The disk shaped spots are red blood corpuscles.

The malaria germ goes through one stage of its life cycle in the stomach of the mosquito, without the help of which, as an "intermediate host," it could not develop. It seems that the pellagra germ is similarly dependent upon the black fly—though as yet Dr. Sambon has not made an explanatory statement in detail on the subject.

Our buffalo gnat is a Southern insect, its chief habitat being the lower Mississippi Valley. Thus it is not surprising that pellagra should have broken out first in that section of the country—supposing the theory of an acquisition of infection by this gnat to be correct. For this reason it is, then, and not because the people of the South eat much corn, that the dreaded malady has spread so rapidly in that part of the United States. In fact, it looks as if it would be necessary to abandon entirely the idea that corn has any relation to the genesis of pellagra—the notion having been that certain unidentified and poisonous fungi

'UNDER SUSPICION."
This golden-hued fly of the Sudan is believed to carry disease.

in moldy maize were accountable for the mischief.

One should remember, of course, that the accountability of the buffalo gnat is as yet unproved. It is merely a theory. But, if the nearly-related Italian midge is responsible for pellagra, it is necessary to look for the same cause in this country, which is only to be found by assuming that one of our own species of black flies of the same genus has become infected. The disease has been conclusively shown not to be communicable from one person to another by any ordinary means of contagion or infection, yet it is rapidly spreading in the United States. How explain this fact in any other way?

Many Italians sick with pellagra have reached our shores within the last few years. We were not even acquainted with the disease ten years ago. Suddenly it breaks out. A few scattered cases are discovered in the South. Then, less than three years ago, it begins to spread with great rapidity. Taking into view the non-contagious character of the malady, does not all of this point at least very suggesively to an insect cause?

Within a twelvemonth pellagra has appeared for the first time in the Northern states, and there has been an epidemic of it in an insane asylum in Ohio. How can the Southern buffalo gnat be accountable for these cases, inasmuch as the insect does not occur in the North? The answer is that other species of the same genus, known to science as *Simulium,* are found practically everywhere in the United States. The well-known "black fly," so notorious as a pest in the Adirondacks, is one of these. There is at least a possibility that several of our species of midges are capable of carrying and distributing pellagra. The disease is one of

THE BUFFALO GNAT.
It is now almost certain that this little creature spreads pellagra.

the most dreadful known. Not inappropriately, though inaccurately, has it been called a "kind of leprosy." One of its worst features is that it is apparently incurable after the early stages. The skin of the sufferer reddens and itches, becomes covered with blisters, assumes later on a dirty yellow or yellowish-green color, and breaks in painful cracks, often ulcerating. Hence the name "pellagra," meaning rough skin. Children afflicted with it look like old men and women. Nervous depression and emaciation are among its most marked symptoms, and extreme starvation, heart weakness, dropsy, insanity, and delirium terminate the case and the existence of the patient. Some cases are slow and chronic; others are rapid and acute, bringing death within only a few weeks.

THE SPECIES OF TSETSE WHICH KILLS ANIMALS IN AFRICA.

The Southern gnat, which is typical of the *Simulidae,* is a small black fly, and gets its name from a fancied resemblance to the buffalo—the insect being humpbacked, with a pair of antennæ which look like horns in minature. Its bites cause great distress among mules, horses, cattle, hogs, sheep, and poultry, so that "gnat years," when the species is more than ordinarily prevalent, are greatly dreaded in the lower Mississippi Valley. The swarms appear with the first warm weather in spring, and the insects lead a roving life, drifting about with the wind, which often carries them long distances beyond their usual haunts.

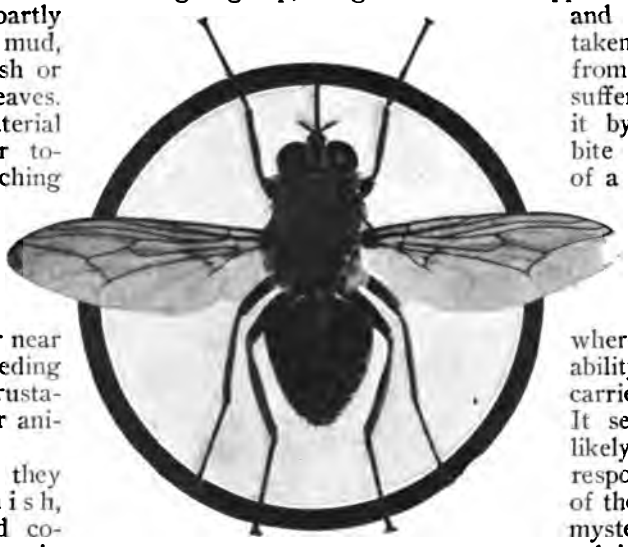
They are incredibly active and bloodthirsty, and their flight is very swift and powerful. When one passes close to the ear, the sound is faintly like that of a bullet. Evidently their senses are very acute, enabling them to find animals a long distance away. When trying to enter houses or stables by way of the windows, they will keep on butting their heads against the glass panes until they become exhausted and drop dead. It has been ascertained that the swarms are composed exclusively of females, which, having attended to the business of laying their eggs near the place where they assumed the winged form, thereupon go abroad in search of blood. Having got it, they soon die.

Occasionally they kill human beings by their bites. It has recently been discovered that these and other species of black flies are provided with poison glands, which secrete a venom somewhat similar in its physiological effects to that of the rattlesnake. No wonder, then, that domestic animals quickly succumb to their attacks. Mules seem to be most susceptible; horses and cattle suffer greatly, and fowls are killed outright, the insects getting under their wings, so that they cannot be dislodged. Deer lose all fear under such circumstances, and in their agony will actually allow people to rub the gnats from their bodies.

When the insects are very numerous, the whole air is filled with them sometimes, and one sees suffering brutes surrounded by a veritable haze of black flies. Sweeping a hand rapidly through the winged swarms, one can collect hundreds of them with a single stroke. They crawl into everything, and fill the mouth, nose and ears of the laborer in the field, who is soon compelled to abandon his work. There may be no indication of gnats in the neighborhood, and the unwarned farmer, dreaming of no danger in passing by thickets of bushes near the roadside, is suddenly assailed, and is frequently unable to reach a place of safety in time to save his mules or horses. Under such circumstances the only thing

to do is to run for an open space, where there is hot sunshine, which the insects cannot endure.

The gnats lay their eggs upon grass or stones close to the water, on stream banks or in other such situations, where they are afterwards overflowed. Their larvæ, when hatched, are aquatic, and need rapid water and something to grasp, such as sticks partly embedded in mud, submerged brush or logs, or fallen leaves. On such material they cluster together, attaching themselves by slender silken threads, and sway with the ripples at or near the surface, feeding on minute crustaceans and other animalcules.



THE SPECIES OF TSETSE FLY WHICH CARRIES THE TERRIBLE SLEEPING SICKNESS.

Later on, they spin brownish, pouch-shaped cocoons, deep down in the water, which are fastened securely to stick or leaf at or near the bottom. From these they emerge after about five days, having assumed the adult or winged form, and, rising rapidly to the surface, they run over the water for a short distance, and then fly away with great swiftness.

One reason why the new discovery in regard to pellagra is so interesting is that it is in a line with certain theories on which science is now busily working—theories, that is to say, which have to do with the possible distribution of many kinds of diseases by biting flies. Much has been already published about the house fly as a carrier of typhoid and other disease germs; but this is an entirely different matter, inasmuch as Musca domestica does not and cannot bite. It is not, therefore, in any proper sense the "host" of a human disease parasite. The black fly, on the other hand, has been identified by Dr. Sambon as an animal which affords to the pellagra microbe an opportunity to develop, and which, having taken it with blood from the body of a sufferer, introduces it by a subsequent bite into the blood of a healthy person.

There are many kinds of biting flies, especially in the tropics, where, in all probability, they serve as carriers of diseases. It seems altogether likely that they are responsible for many of the "curious" and mysterious maladies which afflict the Torrid Zone all around the world. Hence the importance of the investigative work which is now being carried on by scientists connected with the Wellcome Research Laboratories at Khartoum, in the Sudan, who are making a systematic study of the biting flies of tropical Africa, including, of course, the notorious "tsetse," most dangerous of them all, which is positively known to be accountable to the very heavy charge of distributing the frightful complaint that goes by the name of "sleeping sickness"—a malady engendered by a wormlike animal organism which feeds upon and destroys the red corpuscles of the blood.

COURTESY U. S. RECLAMATION SERVICE.

LOOKING DOWN INTO ONE END OF THE SIPHON THAT IS TO PASS UNDER THE COLORADO RIVER.

IRRIGATION MIRACLES

By

ROBERT FRANKLIN

THE carrying out of the various irrigation enterprises conducted by the Reclamation Service in the West has put the engineers "up against" some very novel and interesting problems. One of these is now being solved by passing a "siphon" under the Colorado River—the siphon in question being a cylindrical tube 1,000 feet long and fourteen feet in diameter, lined with cement.

In order to make clear the object in view, it should be explained that the Colorado River, at the point where the hole is being dug beneath it, near Yuma, passes between lava bluffs. Some distance further up is the Laguna Dam, built to impound a large body of water, which is to be carried out over the land by two big canals, one on either side of the river, for irrigating purposes.

The main body of the water thus diverted from the river channel, however, is to be brought down by the canal on the California side, because, on the Arizona side, it is hardly practicable to fetch it across the Gila River, which flows into the Colorado just above Yuma.

The easiest way the engineers could find to get around the difficulty was to bring down the main body of water on

the California side (as aforesaid), and, at a point opposite Yuma, to pass a large volume of it under the Colorado River, thus getting it over to the Arizona side, where it is badly needed. This is to be accomplished by digging a tunnel 1,000 feet long, which, when finished, will supply water to many thousands of acres of thirsty Arizona fields.

The canal on the California side (from which the water is drawn) is considerably higher than the outlet of the tunnel on the Arizona side. Thus by mere gravity the water will pass down, across under the river, and up and out at the other end. There will be no necessity for pumping it. Hence the tube is called a siphon—though of an inverted kind.

Now, the difference in elevation between the canal on the California side and the outlet on the Arizona side is so considerable that the water will come out of the Arizona end of the tube under high pressure—because, as will be understood, it seeks its own level. This pressure will be used to develop 1,000 horse-power, which will be turned to account for pumping some of the water onto the high mesa just outside of Yuma.

It is a very interesting performance from an engineering standpoint. To expedite matters, the digging has been started on both sides of the river—that is to say, at both ends of the proposed tunnel. It will be necessary to go down to a depth of forty-five feet on the California side, in order to pass the tube beneath the bed of the stream. A photograph herewith presented was taken from above looking down into one end of the siphon, and shows the diggers at work.

Equally remarkable in its way is an engineering enterprise that is being carried out on the Williston Project, in North Dakota. There the government has gone into the business of digging coal from its own mines, a large area of public lands having been set aside for the purpose. It just happened, by a piece of good fortune, that the Reclamation Service got hold of the coal before private corporations had a chance to grab it.

At the mines a big power plant has been established, which sends power, in the shape of electricity, over a distance of eight miles to the Missouri River, where a very novel and quite unique pumping plant has been set up on a floating barge attached to the bank of the stream by large flexible pipes. Pumps, worked by the electricity thus obtained, force water from the river through the pipes into a large settling basin, from which, after allowing time to get rid of most of its sediment, it flows by gravity into canals.

The reason for adopting this remarkable expedient is that the Missouri River cannot be utilized in the ordinary way by gravity canals. There is no available foundation for a dam, and the fall of the stream is so slight that canals of enormous length would be required to get the water out over any large area. Also the river is constantly shifting its channel and eating away its banks. By the means above described, however, the Reclamation Service will irrigate 16,000 acres of

COURTESY U. S. RECLAMATION SERVICE.

CONCRETE MIXER DISCHARGING INTO CHUTE, WHICH CARRIES CONCRETE TO BOTTOM OF THE GATE SHAFT.
Okanogan Project, Wash.

COURTESY U. S. RECLAMATION SERVICE.

TRESTLES OVER WHICH THE DIRT FROM THE HILLS IS BROUGHT TO MAKE OUR BIG "FILL."

rich land, suitable for garden truck, sugar beets and alfalfa. It may be added that there is enough coal available at the mines to run the pumping plant for 150 years.

On the Huntley Project, in Montana, not far from the little town of Ballatine, the Service has established a large pumping plant by the adoption of other means. It has used for the purpose a drop of thirty feet in the main canal, directing the water through a pressure pipe upon a turbine. The turbine in its turn operates a centrifugal pump, by which the water is lifted sixty feet and poured out over 3,000 acres of some of the finest land in the world, available for growing cereals and all kinds of vegetables, as well as for sugar beets and apples.

COURTESY U. S. RECLAMATION SERVICE.

THE CANAL THAT WAS BUILT THROUGH THE AIR.

The engineers jocularly refer to this enterprise as equivalent to a successful attempt to lift one's self by one's bootstraps—inasmuch as the power of the water is used to raise the water itself thirty feet higher than the level of the canal that furnishes the power. But, of course, it is only some of the water that is thus lifted.

Decidedly unique in its way is an expedient that is being adopted, on the Okanogan Project, in Washington, for building an immense earthen dam by hydraulic process. Here was a case where a gap between two high hills had to be filled in. For this purpose the readiest means seemed to be to tear down the hills on either side, and use the débris for the "fill"—the work being done by directing against the hillsides a tremendously powerful stream of water, and fetching the material over to the site of the dam through flumes supported on high trestles.

It happened by great good luck that, at a distance of only two miles above

COURTESY U. S. RECLAMATION SERVICE.

A PUMPING PLANT ON THE BANKS OF THE MISSOURI.
Williston Project, North Dakota.

the dam site, a stream was found available for the purpose. It was a mere brook, but flowed down a mountain side so steep that it represented a tremendous amount of available power. Accordingly, its water, diverted through a flume, was brought to the dam site and made to operate what is called a "giant" —that is to say, a mighty hose, which, when directed against the hills, literally tore them to pieces.

The method has been entirely successful, and the dam, sixty feet high and 1,000 feet long, containing 342,000 cubic yards of material, will be finished before long. A useful improvement recently adopted is a means whereby the various kinds of débris fetched from the hillsides —rock, gravel, and earth—are separated in the flumes, and dropped just where they are wanted in the embankment.

THE TECHNICAL WORLD MAGAZINE, in its November, 1909, number, gave a brief description of a canal "built in the air"—referring to the Tieton irrigation canal, near North Yakima, in the State of Washington, which was being constructed by casting the concrete sections in the valley far below, and hoisting them, with the help of a trolley contrivance, up to the level, on the mountain side, where they were wanted.

Two pictures, presented herewith, show this canal after its completion. It is twelve miles in length—one-sixth of this distance being through tunnels piercing great masses of rock which it could not make its way around.

MEASLES AND THE MOUSE

By

RICHARD E. BENTON

IS measles a mouse disease?

The theory is entirely new. It owes its authorship to Dr. A. F. A. King, of Washington, D. C., a physician of high reputation, who shows that, while not yet susceptible of positive proof, it is backed by a great deal of affirmative evidence.

It is by no means suggested that the *spread* of measles is attributable to mice. That is a matter of ordinary contagion, the disease in question being one of the most easily conveyed in this way. Dr. King's idea is merely that the original cases of measles, by which epidemics are started, are derived from mice.

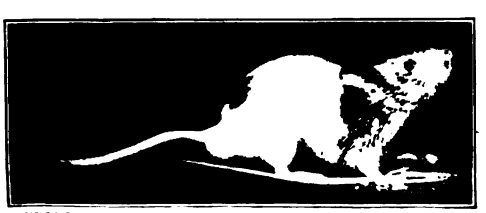
In order to understand his theory, it is necessary to go back as far as the days of Civil war, when it was generally believed that soldiers in both armies got measles by sleeping on *straw*. The "Medical History of the War of the Rebellion," published in Philadelphia in 1865, prints one report of 38,000 cases, with 1,900 deaths, of which sleeping on straw was the recognized cause. In some instances military orders were issued forbidding soldiers to use straw for bedding.

In 1862, Dr. J. H. Salisbury, of Newark, Ohio, obtained from wheat straw the "spores"—corresponding to seeds—of certain fungi, which, when introduced into the body, produced a disease apparently identical with measles. This was very interesting; but, unfortunately, subsequent experiments by Dr. J. J. Woodward and others failed to confirm Dr. Salisbury's results. Dr. Woodward propagated straw fungi by shutting up a quantity of damp straw in a box, and with them inoculated himself and other persons. There was no effect. In commenting on the matter, he said:

"Measles breaks out in barrack buildings where the men lie on the floor on their blankets without straw. It has broken out in camps where no straw was furnished to the men, and where they lay on cedar twigs or on rubber blankets."

Thus it might appear that the suspicions entertained against straw as a source of measles infection were unjustified. But, as Dr. King suggests, if the *mouse* be introduced as a factor in the problem, the whole aspect of the case is altered. The conflicting results may then be reconciled; for it is entirely conceivable that Dr. Salisbury may have made his experiments with straw containing mouse infection, and that such infection was not associated with the straw used by Dr. Woodward.

If Dr. King's notion be correct, it is not wheat straw or any other kind of straw that is accountable for measles, but mice, which so commonly infest straw. Their droppings—he is inclined to think—contain the germs of the disease, which communicate the infection to persons who come into contact with the straw. Dr. Salisbury reported two cases where farmers of his acquaintance got measles from pitching straw from old



THE PRESIDENT'S STABLE AT WASHINGTON.
An epidemic of measles originated here.

stacks and storing it in their barns. Of course—says Dr. King—proof is not obtainable, but it is reasonable to suppose that there were mice in the stacks.

Only a few months ago there was a case of measles in Washington, apparently original—that is to say, not derived from any other case—in which the patient, a small girl, developed the malady after playing in the loft of the White House stables, where she had gone with the children of the stableman. These children got the disease at the same time. The loft contained straw and hay, in which—the stableman said—were "any quantity of mice."

Dr. King remembers that his brother and himself, when they were ten and eleven years old respectively, were attacked by measles after spending several hours helping to kill mice on a wheat rick which was swarming with the vermin. There were no other measles cases at the time, that he can recall, among his neighbors and schoolmates.

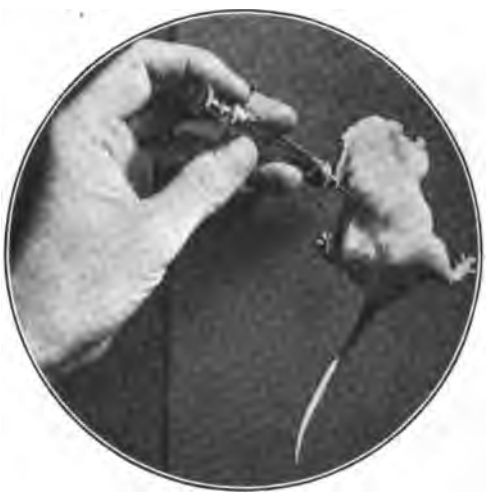
"Some years ago," says Dr. King, "a box of china packed in straw was received in my own house. While unpacking it, I could not get rid of the idea that there was measles in the straw. Fearing lest my own children—who were then very young—might get the disease, I had the box and packing burned without delay. My children escaped, but some days later we learned that the relative in whose house the china had been packed was in bed with measles. She was a grown woman."

Dr. Henry Kennedy reports a case of measles caused by one boy playfully dashing a handful of flaxseed meal into the face of another. The meal entered the youngster's mouth, nose and eyes. Where in this instance was the mouse? Quite possibly, one might reply, in the meal tub.

Measles is so common a disease that the medical experts, one might think, ought surely to have found out all about it by this time. As a matter of fact, however, they know very little. It is to a great extent a mystery. The germ that causes it has not been identified, and the source from which original cases—those that start epidemics—are derived, is—unless the mouse theory be accepted—an unsolved puzzle.

The matter is of no little importance, because measles is by no means so trifling a malady as is commonly supposed. A great many people die of it. Grown persons, when they catch it, suffer much more seriously than children. Furthermore, it occasionally assumes a malignant and very deadly form. For some unknown reason, it is frightfully destructive to primitive races which have not been in close touch with civilization. The rapid disappearance of the Eskimo within recent years is largely attributable to its ravages, the entire populations of whole villages being sometimes literally wiped out within a few weeks by a plague of measles.

There are different types of measles, and many—over 100—species of mice, just as we have different types of malarial fever and many varieties of mosquitoes. If the mouse is the carrier of the



INOCULATING A MOUSE BY HYPODERMIC INJECTION FOR EXPERIMENTAL PURPOSES.

DR. A. F. A. KING.
This physician believes the origin of measles is in mice.

measles germ—as the mosquito carries malaria—it is entirely possible that different species of mice may be accountable for various types of measles.

Peculiar long, curved bacilli are found in the blood and sputum of sufferers from measles; likewise certain sparkling, colorless bodies—some spherical, others spindle-shaped, and yet others canoe-shaped. In malignant measles occur suspicious-looking micrococci, in the white corpuscles of the blood, which latter are actually burst and destroyed by the rapid development of the microbes inside of them. Also there has been found an animal organism—a "protozoön," resembling a familiar type observed in smallpox.

Nevertheless, the germ of measles remains as yet unidentified. Furthermore, up to the present time nobody has succeeded in inoculating guinea-pigs or any of the lower animals with the disease. Human beings have voluntarily subjected themselves to inoculation with blood, mucus, tears, etc., from measles patients, and in many such instances the malady has been communicated. These experiments, however, do not seem to have led to any results of the slightest importance.

This—says Dr. King—is not the way in which the disease is naturally acquired. It is not produced in human beings by an insect bite or a wound of any sort. The initial symptoms—cough, sneezing, sore throat, flow of tears, etc.—all indicate infection by a *germ-laden atmosphere*. Thus, if we admit mouse droppings to be the original source of measles, it is easy to conceive that these excreta, when dried by the warmth of our houses, crushed by passing feet on the floor, and dispersed by the housemaid's broom in the air, might widely distribute the infection.

Suggestion is made that the theory might be tested very satisfactorily by taking a sufficient quantity of mouse droppings, reducing them to a fine powder, and diffusing the latter through the air of a room, to be breathed by children placed therein for the purpose. The obvious difficulty is to get the requisite volunteers.

If it be really the mouse that is accountable for measles, no great length of time will elapse before the specific microbe of the malady will be isolated and identified. This accomplished, there ought to be no difficulty in utilizing it for the production of a

THE "LITTLE HAMSTER."
A curious European species of mouse.

"serum" or a "vaccine" which will serve at least as a preventive, if not as a cure, rendering persons inoculated with it immune to the disease. To make an immunizing vaccine, it would be necessary merely to breed the germs in beef soup, kill them by heat near to boiling, and put up the fluid in sealed glass tubes, to be broken when wanted by the physician for use by hypodermic injection.

THE FIELD MOUSE.

It is a fact worthy of note that measles is a cold-weather disease. Epidemics usually begin in November or December, and continue until April or May, declining and fading away during the summer and autumn. It is likewise noteworthy that mice live in the fields during the summer, but swarm into barns and houses, for food, shelter and protection, during the winter months. Are these two facts connected?

One of the greatest mouse plagues of recent times occurred in Scotland only a few years ago, and lasted from 1887 to 1893—a period of about seven years. This period—says Dr. King—was also marked by an enormous increase in measles. According to the official mortality records, there were in Scotland, in 1886, just 681 deaths from measles. In 1887 the number rose to 1,598. In 1888 it was 1,406. In 1889 it was 1,948. In 1890 it was 2,509. In 1891 it was 1,775. In 1892 it was 2,480. In 1893 it was 3,639. But in 1894 there were only 791 deaths from measles. The mouse plague had suddenly come to an end through the development of an epidemic which wiped out the rodent armies wholesale.

There seems to have been at least one region where the inhabitants for a long term of years were exempt from measles. From 1781 until 1846—a period of sixty-five years—there was not a single case of the disease among the—then—7,782 inhabitants of the Färöe Islands. In 1846 an infected man left Denmark, sailing from Copenhagen March 20. Three days after his arrival at Thorshaven he sickened with measles, and from him more than 6,000 of the islanders acquired the malady.

J. Russel Jeafferson, F. R. S., in a recent book on "The Färöe Isles," page 74, says: "I learned

DORMOUSE—NATURALISTS SAY THIS IS NOT A TRUE MOUSE.

that some of the islands are *entirely exempt from the mice pest.* It is said that these islands were in olden times freed from the vermin by the curse of a powerful wizard, and that people whose houses are infested with mice use some of the soil from these islands, which is believed to expel the mice from their dwellings."

As a matter of fact, the absence of mice on the islands seems to be due to the scarcity of cereal grains, and to the great number of cats kept by the inhabitants. Owing to frequent hurricanes, it is impossible to cultivate the taller grains, such as wheat and rye. But Dr. King finds significance in the circumstance that in Russia, which is frequently beset by innumerable armies of mice—owing to superabundant harvests of cereals—there is great mortality from measles, whereas in the Färöe Islands there are no grains, no mice, and no measles.

If it shall be definitely established as a fact that mice are accountable for measles, it will be necessary to inaugurate a persistent and scientific war against those vermin. The difficulties involved would be not less serious, perhaps, than those which beset the mosquito problem. It will never be practicable to exterminate either the mosquito or the mouse, but the number of mice can be greatly reduced by the adoption of proper methods, and much may be done to prevent the spread of measles—if mice are really responsible—by making houses mouse-proof.

GOLD EAGLES FROM GOLD FISHES

By

FULTON G. MARSHALL

WHERE do the gold fishes, which the glass bowl in the parlor proudly boasts and which the magician on the stage pretends to eat with such realistic gusto, come from?

Millions of them come from a little farm in southern Iowa, where they are raised the same as oats and corn, hogs and cows. That is, the same, only different.

It is a fact, curious but true, the average Iowan does not know that his state leads the nation in the production of gold fish. He prates glibly of corn and corn-fed steers and hogs. He knows that the matutinal oatmeal was raised and rolled within the state's confines. He stands unabashed before the world and proudly boasts that there is room enough in the automobiles owned by the farmers of his state to hold the salaried politicians of half the commonwealths of the union, that the talking machines to be found in the farm homes of Iowa, if set to running simultaneously, could be heard a thousand miles. But of gold fish he knows nothing, save that his mother-in-law's sister has a niece who has a bowl full of the fish in her home, back in Ohio, and he always wondered what earthly use they were.

Which simply shows that gold fish breeders, like prophets, are not without honor save in their own country.

As long ago as 1842 Elgin K. Bruce, Sr., carried on the business of raising and selling gold fish. That was in Pennsylvania. In 1877 the Bruces migrated to Iowa and settled alongside a slough in Keokuk County, near what is today the somnolent village of Thornburg. There was no village then and people marveled that as bright a man as the elder Bruce appeared to be should have passed by the fertile uplands and the alluvial lowlands and chosen a meandering slough which seemed fit only for draining or drying up. But the elder Bruce had good reason to believe that

THE PEARL GOLD FISH.
The reason for this name is obvious.

the natural slough would easily resolve itself into a feeder of artificial lakes where gold fish might play hide and seek among the lily pads, soak up the Iowa sunshine and mint themselves into gold eagles.

Today the visitor to the Bruce gold fish hatcheries at Thornburg marvels at the ideal location and arrangement. Alongside the slough lie seventeen ponds, varying in area from a few rods to six acres. Adjacent to them are graveled walks and cultivated fields, windmills and reservoirs of fresh water. In these ponds a half million gold fish lead a happy existence, recking naught of the day when they will be summarily dipped out of the friendly waters, sorted over for size and brilliancy of colors and sent out into the big world to adorn a metropolitan aquarium, mystify a vaudeville audience or splash with color the glass bowl of some maiden lady housekeeper with a penchant for pets which are little care and always stay where they are put.

In these seventeen ponds are to be found eight kinds of gold fish: plain, comet tail, fringe, fringe fantail, Japanese fantail, American fantail, nymph and telescope. The young gold fish are not unlike ordinary, creek-variety minnows. When they are a fortnight old they are taken out of the pond in which they first saw the light of day and are transferred to a shallower pond, where the bright rays of the sun as it ripens the corn and small grains of Iowa's fertile fields also burns upon the tiny scales the brilliant colors of the rainbow. The little wigglers expose their sleek, shiny bodies to the rays

SEVERAL OF THE PARADISE VARIETY.

A POND OF THE GOLDEN FISHES

and as they dart hither and thither in search of food or in play Old Sol gets in his work. The coloring process lasts from a week to four months, according to the weather, the sun being aided by the use of especial food and by the occasional cleaning of the coloring pens or ponds. Gradually the bright red, deep orange, shining silver, glittering gold and the many and brilliant hues become permanently imprinted on the scales and the ponds become tremulous rainbows of shimmering water.

Once the coloring pens have been passed, the gold fish go into various ponds, according to their size, color, tribe, age and stage of development. The first pond, which gleams with gold, is inhabited by some 600,000 comets, which, when of a marketable age and color, bring from $10 to $20 a hundred. The next pond is fairly alive with Japanese fantails, running the color gamut from bright red to black, white, silver and orange. These are more valuable and bring on the market from $10 to $40 per hundred. To the left is a pond full of valuable and rare telescope fish, with eyes projecting half an inch from their awkward heads. In other ponds are other breeds and tribes, some beating out their prismatic glory on hidden rocks and roots, all at the mercy of the darting enemies of the air (the kingfisher, wild duck, heron, crane, cormorant and the water fowl) and all awaiting the day when they shall have passed the chrysalis stage in the home ponds and graduated

COMET GOLD FISH, TWELVE INCHES LONG.
This fish was exhibited at the St. Louis, Portland, and Seattle exhibitions.

AT THORNBURG, IOWA.

into the display world, to the enrichment of the Bruce coffers. In one pond are fourteen old spawners, for which the owner will take no price. They are fine large fish, from ten to fourteen inches long and from twelve to eighteen ounces in weight. They are very rare varieties and supposed to be from 15 to 25 years old, for be it known that fish have lived to attain 200 years and still been active and useful enough to escape Oslerizing.

Color, shape, fins and tail, variety and age establish the price of gold fish, which ascend a chromatic scale of values during four years until, in the fourth year, all are salable. Thereupon the ponds are drained by means of siphons until the fish are easily caught up in long-handled dip nets and transferred to baskets made of galvanized wire netting. After 2,000 or 3,000 fish are in a basket it is carried to the sorting tank in the fish house and there the work of classifying for the market is carried on. Mr. Elgin K. Bruce, Jr., the present head of the house of Bruce, is a firm believer in selection. When he sorts the gold fish to be put on the market he invariably saves for himself the finest of the lot. They go back into the breeding ponds and from them are produced the fish which bring as high as $25 each on the market, for there are aristocratic specimens of gold fish as well as of Holstein cows, Percheron horses and White Orpington chickens. The prices run from $5 a hundred to $25 each and the work of sorting is carried on carefully.

The fish are shipped out in cans with perforated tops and go by express half way across the continent, usually in safety. An 18-inch can, 8 inches deep, holding fifty pounds of water, is sufficient to transport 100 fish, without change of water, to Denver or Rochester, in the ordinary course of traffic. A 32-inch can, 8 inches deep, holding 100 pounds of water, suffices to transport from 300 to 500 fish the same distance, under equally favorable conditions. Orders come in practically all the year around, from practically all over the country. Kansas City has proved itself one of the best jobbing markets in recent years, more orders being received from that hustling gateway of the Southwest than from many a larger city, such as

A SPLENDID SPECIMEN OF THE FRINGETAIL.
The parts showing black in the illustration are blood red in the living fish; the tail is white.

JAPANESE FRINGE FANTAILS.
The fins and tails are almost "flimsy."

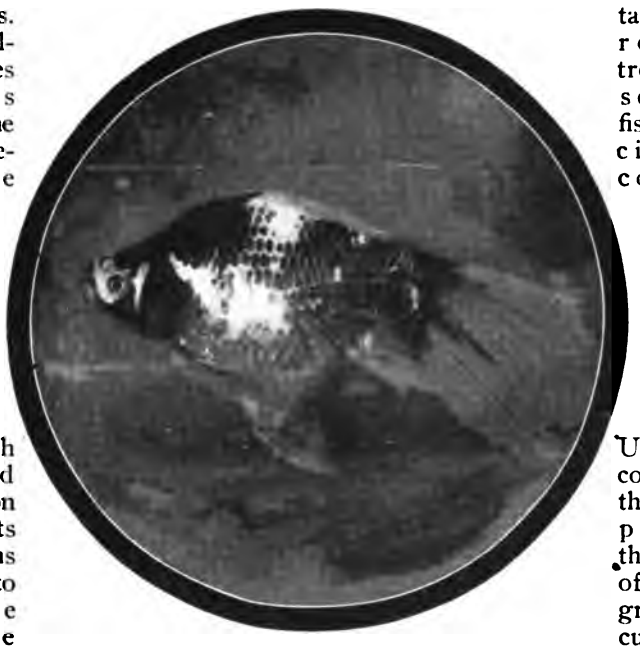
Boston, Philadelphia or St. Louis.

To conduct the Bruce gold fish hatcheries requires the services of three men and a woman all the year around, while when the fish are being sorted for the market it is no unusual sight to see a dozen or more young people from the neighboring village assiduously seining the swarming, iridescent fish. But the real work lies in feeding and keeping the little fish in the shallow ponds until time and the sun have done their work in coloring their bodies. At the Bruce hatcheries 100 pounds of oatmeal are cooked and served the gold fish every day. The fish also eat or nibble at a variety of moss. The utmost care is exercised to keep the water in the various ponds pure. The frogs see that the pure food law is complied with and devour all the impurities which creep in to the possible detriment of the delicate tint or

TELESCOPES, SO CALLED BECAUSE OF THE PROTRUDING EYES.

brilliant color of the gold fishes. The ponds are filled by means of the windmills, the source being wells of a splendid quality and apparently unlimited quantity of water.

The chief worry and loss of income is the destruction by hungry birds. Of the half million gold fishes in the ponds early in June only about one-half come through the summer to maturity and the market. Mr. Bruce makes a standing offer of $25 for the destruction of each omnivorous bird and traps on adjacent posts and shot guns always ready to hand remove many of the cranes and kingfishers and their ilk, but still the gold fish perish by the hundreds of thousands before they are ready for the shipping can and the glass bowl.



NYMPH GOLDFISH.
The veins in the fins and tails are plainly distinguishable.

The present hatcheries are to be enlarged, four more ponds to be installed, so that there will be every facility for breeding the finest gold fish in the world. By the policy of selection a high standard is being bred up and it is Mr. Bruce's ambition, which bids fair some day soon to be realized, to put on the market new and strikingly beautiful specimens of gold fish. In carrying out this purpose, however, he realizes that he is engaging in an unprotected industry in open competition with the entire world. The Payne-Aldrich tariff law, like all its predecessors, takes no cognizance of the gold fish. Gold fish breeding is an industry so infantile that the mighty minds of Congress have never bothered with it, not deeming it of sufficient importance to need protection, although the output has ranged from 100,000 to 1,000,000 fishes each year for the past quarter century, and $10,000,000 worth of gold fish are imported each year.

"Notwithstanding the policy of Congress in letting us blissfully alone, without regard to tariff duty or reciprocity treaty, we are selling gold fishes in all the cities of this country and even shipping them to Canada, Mexico, England and Italy," says Mr. Bruce. "Foreign fish are brought into the United States in competition with the home grown product, but they are usually of an inferior grade. The difficulty of transportation is another important factor in favor of the American-bred fishes. I import from 300 to 400 gold fish every year and an experience this spring is typical. I imported fifty fine specimens of the telescope variety. They were shipped across the ocean from Japan and reached San Francisco in safety. They traveled across the United States to Cedar Rapids, Iowa, in safety, but in the last 80 miles, from Cedar Rapids to Thornburg, the road was so rough that the eyes of every one of those fifty fish were knocked off on the sides of the can as the train jolted along. The fact is that the finest Oriental gold fish come right from these Iowa ponds alongside the Iowa corn and oats fields. There is not a pond in the world better for breeding, raising and coloring gold fish than a pond the bottom and banks of which are black slough mud. It's another case of 'made in Germany' being a brand rather than a geographical identification,

A HAPPY FAMILY OF VARIOUS SPECIES.

for Japanese gold fish are raised and colored better in Iowa than in Japan."

The market for gold fish is not decreasing, as the average person (missing the old fashioned round bowls on the parlor center table) might be inclined to think. The falling off in the demand of individuals has been offset by the increased demand of museums and aquariums. Schools are good customers, while there are just enough old fashioned folks scattered all over the country to want a dash of vibrant, iridescent color in their parlors and living rooms and who take pleasure in watching the glowing little bodies glide through the water at the call of the crumb, bringing the beautiful in life into the home, even though it be in the limited confines of a small glass bowl.

One of the striking characteristics of the gold fish, that can not escape the notice of those who are at all acquainted with the little creature, is the tenacity with which it clings to life. In spite of the abuse that is often unconsciously meted out, in the way of negligence in the feeding or in changing the water, on the part of the possessor, it thrives and flourishes where fish of many another species would, in all probability, succumb through such carelessness.

This feature is an advantage to the breeder, not only in the rearing of his finny crop, but also in inducing people to purchase the same.

The gold fish is said to be of Chinese origin. From China it has been introduced, solely for ornamental purposes, of course, into many of the streams of Europe and the United States, though the really fine varieties are to be found nowhere outside of captivity.

A JAPANESE FANTAIL AND A PARADISE GOLD FISH.

MORE VARIETIES OF THE GOLD FISH.

It must not be inferred from what has just been said, however, that gold fish will prosper or even live with any kind of treatment. If one is making a business of raising the species, of course he must understand the whole matter thoroughly, and undertake the work on a scientific basis. The gold fish industry is very remunerative, as has already been indicated, but remunerative only when carried on with patience, knowledge and common sense.

Some of the state fish hatcheries, where steps are taken to propagate and perpetuate favorite species of game and other edible fishes, also breed gold fish, though, of course, no state government is offering them for sale.

RECORD RUN ON ELECTRIC RAILWAY

BY

C. B. EDWARDS

RETURNING from the longest continuous electric railway trip ever attempted, twenty-one citizens of the city of Utica and officials of the Oneida Railway Company were welcomed by the populace of Utica at the selfsame place they had started from two weeks previously on their 2,000 mile journey in the same car. Over trackage extending through the states of Michigan, New York, Ohio, Indiana, and Pennsylvania, car No. 502 sped on its long journey, encountering the tracks of twenty-six separate railway corporations welded into a seamless bond of rail connection that would extend halfway across the continent.

No changes were necessary in the running gear and trucks of the car, except the changing of the flanges on the trucks to conform to the varying kinds of switches and tracks encountered. The schedule made out by Manager Allen of the Oneida Railway required that the running time for the entire journey average thirty-eight miles an hour, and with the four powerful motors with which the car was equipped this was easily maintained, the car on some stretches making sixty miles an hour.

The result shows most conclusively that the electric railroads of the country are becoming standardized to a certain equipment which will admit of through cars being run from the Atlantic to the Pacific. In only one instance was it impossible for the car to travel under its own power, that being in Indiana where the current was of a different

CAR WHICH WENT ON THE TWO THOUSAND MILE TRIP.

voltage. A few changes along the lines of the different roads traversed were also required. To enable the car to get out of Rochester, a special switch was required, and on one road it was necessary to prop up a highway bridge at Erie, Pennsylvania, to allow the big car to pass under. Only in a single instance were the occupants of the car in danger and that was when a member of the party accidentally pulled the emergency lever and the car came to a dead stop in front of an approaching train. The motorman was equal to the emergency, however, and released his brakes and threw on his power before the train was within a hundred feet of the car. The detailed route of the trip showed that seventy-five hours and fifty-six minutes were consumed in running time in making the total distance of 1,939.16 miles.

The trip seems to have proved that the electric car can perform an equal service with the steam train. The following cities were visited: Utica, Rochester, Erie, Pa., Cleveland, Columbus, Dayton, Indianapolis, Louisville, Ft. Wayne, Toledo, O., Detroit, Buffalo.

INTERIOR OF THE CAR WHICH MADE THE UNUSUAL JOURNEY.

SEARCH FOR ELIXIR OF LIFE

By

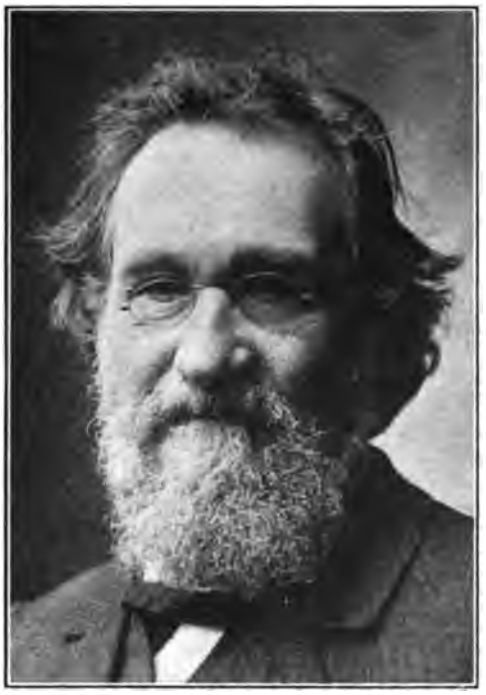
EDFRID BINGHAM AND WILFRED ROQUES

SCIENCE has no more fascinating task today than that imposed upon itself to fulfill for the average man the promise made to Job after his years of bodily suffering and spiritual anguish: "Thou shalt come to thy grave in a full age, like as a shock of corn cometh in his season." Recent years, and especially recent months, have seen an enthusiastic renewal of that search for the "Elixir of Life" that has allured alchemists and dreamers for centuries. The discovery of bacteria gave a fresh impulse to that adventure; the elaboration of the theory of microbes brought yearly more encouragement; the creation of anti-toxins that actually checked some of the most dreaded diseases of the human body spurred the imaginations of the doctors and the public alike; and the cautious scientists of the Pasteur Institute and other such places of research have felt that they were on the verge of some great discovery that would startle and overjoy the world. There have been premature announcements made by doctors carried away by their enthusiasm, and theories about which learned battles have raged and are still raging. Many promises of the laboratories have not been fulfilled. The value of some anti-toxic remedies is much disputed by sceptical practitioners. But, for all that, the advance toward "a full age" for man has been perceptible and the attack upon malevolent microbes continues in full confidence that science will realize at least a portion of the dream.

The scientific world in France is now in a state of agitation and of controversy over the announcement recently made by Dr. Eugene Louis Doyen, a famous physician and surgeon, that he has produced a therapeutic agent which he calls micolysine and which he asserts will greatly prolong human life and revolutionize the practice of medicine. This discovery is the result of ten years of study in which he has applied the theories of Professor Elie Mechnikoff, the venerable head of the Pasteur Institute, to the creation of a new pharmacopeia. In order to understand fully the efforts of Dr. Doyen in this direction it is essential to review briefly the momentous discovery for which Professor Mechnikoff received the Nobel prize for scientific research in 1903.

It is not necessary that one should be a doctor or a scientist to have asked many times the question why, in cases of epidemic, for instance, some members of a family will fall ill while others will escape the disease. It was upon this fact, well-known but hitherto unexplained, that Pasteur began his epoch-making studies of the powers of resistance in the living organism. He found then that infectious microbes could be developed in the blood of certain animals, such as the horse, while it enjoyed apparently perfect health. There followed the production of anti-toxins to combat diphtheria and other scourges. But Professor Mechnikoff, succeeding Pasteur in the famous institute, announced at length the vital theory that in the human organism one long fight is going on between the movable cells belonging to the organism and the evil microbes which have invaded it. These movable cells Professor Mechnikoff named phagocytes, and the ensemble of the function which assures immunity he called phagocytose. In experiments on human organisms, in all cases of the introduction of infectious microbes, there has resulted an accumulation, an increase, of movable cells, more especially the white corpuscles of the blood, which surround, incorporate and destroy the microbes. If rabbits or

guinea pigs, not first immunized, are inoculated with the bacilli of carbuncle, the microbes find themselves free in an abundant liquid where the white corpuscles are almost powerless. But if a similar inoculation is made in a rabbit or



PROF. ELIE MECHNIKOFF.
This scientist has set forth a new theory as to the cause of old age.

a guinea pig previously vaccinated against carbuncled illness, a different sight is presented, the bacilli being quickly seized by the white globules which rally in numbers at the spot of inoculation. In the interior of the white globules, or phagocytes, the bacilli are killed in a more or less limited time. The result has been found to be the same in many maladies which are now effectually resisted by the process of assisting the white globules by means of the so-called anti-toxic substances; but with the difference that certain bacilli are more powerful than others, and the resistance to them must be stronger and more prolonged. The tetanus bacillus, one of the most deadly of all, will remain alive a long time within the white globule that has devoured it. The effects of the disease may not appear but it does not follow that the microbe has been killed; and as soon as the white globule undergoes deleterious influence, such as sudden heat or cold, the imprisoned spores liberate themselves and soon give rise to mortal tetanic cramps. To the strengthening of the phagocytes in the living organism, enabling them to combat the microbes, many scientists have devoted themselves, especially such men as Behring, Bail, and Weil, whose use of counter-bacterial poisons is believed to have advanced perceptibly the fight which now absorbs the attention of the greater part of the scientific world.

Now, right here is where the difference of opinion arises among the investigators, and where the present investigations especially direct themselves. It is the theory of Professor Mechnikoff, in a general way undisputed, that old age is the result of the unequal struggle between the noble elements in the human organization and the malevolent microbes. But there is dispute over the exact role that the phagocytes play in this long-drawn battle. The phagocytes fight microbes, but Professor Mechnikoff contends that they also devour the nervous cells of the human organism when the latter do not offer sufficient resistance. To strengthen the phagocytes would then, in his opinion, be only to invite greater dangers by upsetting that equilibrium which is perfect health. But Dr. Doyen comes forward with a new idea, which is causing the most lively disputations in scientific circles. He asserts that by permanently strengthening the phagocytes, maladies can be prevented, and that the noble elements of the organism, less attacked by microbes and consequently less quickly weakened, will become a prey to the phagocytes, if at all, much later than they otherwise would. He has worked long upon the idea that if the human body can be fortified to successfully resist the ravages of tetanus, diphtheria, rabies, certain fevers and other fatal assaults of microbes, why may it not be made practically immune, so that there shall be no scars of battle with microbes, and none of the weakenings that follow illness and mark the deterioration of the bodily tissues with advancing years? Not only cure, but

prevention was the aim with which he searched for a substance that would regularly and with a certain degree of permanence increase the powers of the phagocytes in their contests with microbes.

"It is feasible," said Professor Mechnikoff, with his habitual caution, when questioned concerning Dr. Doyen's discovery. "But I can scarcely permit myself to hope that we have reached this point so soon. It is a devious path we have been pursuing, and while I am confident of ultimate success I must refrain from expressing an exact opinion until the data of experiments are more nearly complete."

Dr. Doyen himself is unreservedly enthusiastic. He declares that he and his assistants have observed the curative effects of micolysine in hundreds of cases, and that among his own patients are many prominent men who have been cured of long-standing diseases and who now use micolysine as a preventive.

DR. EUGENE LOUIS DOYEN.
He has discovered, he believes, a means to prolong life.

"I cannot yet consent," said Dr. Doyen, "to make public the process of manufacture of micolysine, or to reveal its chemical composition. Some of the component parts are very rare, and the compounding of the substance is a delicate process requiring the close attention of one thoroughly familiar with the subject, and in touch with the studies that have occupied me for many years. I will, however, explain something of the character of my researches and discoveries.

"It has been well established that in an organism rendered immune against disease the white globules of the blood, the phagocytes, are the protectors of the organism against the microbes. It has been my hope, not merely to increase the number and the strength of these globules to resist certain attacks of deadly microbes, but to render them permanently, or at any rate for long periods, capable of carrying on their protective tasks. To produce this hyperphagocytose, or state of immunity, I sought a substance contained in the natural ferments. I had long investigated the fermentations of alcohol such as are found in wine and beer, as well as those in the putrefaction of butter, and the fats of meat and cheese. Micolysine is composed of colloids. These are jelly-like substances which are not really soluble, but which remain suspended in liquids in infinitesimal particles. They are extracted from some of the ferments of which I have spoken, but are obtained by such processes as make their manufacture for therapeutic purposes at present very difficult. They have the power to destroy microbes, and when introduced into the organism they stimulate and assist the phagocytes, which are accustomed largely to disappear when their immediate work is done. By the absorption of micolysine into the human system not only as a cure but as a preventive it is possible to ward off maladies, to stimulate the phagocytes in times of danger and to condition the body at any moment to sustain the attacks that are constantly aimed at it by the thousands of enemies of human life that minutely infest the air, and water, and the food that nourishes us.

"I will not attempt to claim too much, in the present state of my experiments;

but I do say that the use of micolysine will make possible the lengthening of the average human life by fifteen or twenty years. I know that it arrests almost immediately such maladies as colds in the head, sore throat and grips, and in fact most of the affections of the respiratory passages; carbuncle, eczema and many other diseases of the skin, even cancer when used in connection with electricity; many ailments of the digestive passages; puerperal, typhoid and eruptive fevers; chronic rheumatism and tuberculosis. Eliminate these diseases, not only by cure but by prevention, and we have gone a long way toward the goal of a ripe and active old age, prolonged beyond the traditional three score years and ten.

"From the standpoint of the present familiar pharmacopeia, these therapeutic colloids are not pharmaceutical substances. They will in fact cause a revolution in the old pharmacopeia. Micolysine has absolutely no harmful effects, either upon an invalid or a person in good health. It is administered either through the stomach or hypodermically. More than this I am not at present ready to divulge in any public manner, though physicians in every country will be accorded every possible opportunity to conduct experiments for themselves with this cure."

PASSING OF THE STEAM TRAIN

By

SAMUEL O. DUNN

ON January 8, 1902, a suburban train on the New Haven was run into from the rear in the Park Avenue tunnel in New York City by a local passenger train on the New York Central, the engineer of which, on account of dense smoke in the tunnel, did not see or properly read the block signals. The steam and gases which poured in great volumes from both locomotives soon filled the tunnel; the passengers,

A SHORT HAUL FOR THE FARMERS.

Showing one of a chain of thirty-six grain warehouses that have been built at short intervals along the lines of the Inland Empire Electric Railroad in the rich Palouse country of eastern Washington and northern Idaho.

AN ELECTRIC LOCOMOTIVE WITH ITS TRAIN OF PASSENGER COACHES.

hedged in by the walls of the tunnel, could not escape; and fifteen were taken out scalded or suffocated to death.

This accident brought home forcibly to the managements of the New York Central and the New Haven the dangers of running steam trains through the Park Avenue tunnel. Advocates of electrification said the only way to make the tunnel safe was to electrify it. Electrification of the tunnel meant electrification of the entire terminals used by the New York Central and the New Haven. To pull the heavy through passenger trains of these roads would require heavier and faster electric locomotives than any ever built.

An experimental electric locomotive, the biggest up to that time in the world, was built for the New York Central. In 1904 a speed test track, electrically equipped, was laid parallel to the main line of the New York Central and near Schenectady, N. Y. One day when the New York Central's Empire State Express, one of the fastest trains in the world, approached Schenectady, running sixty-five miles an hour, the engineer saw ahead of him on the test track the electric locomotive with a long train of coaches hitched to it. The electric train stood perfectly still until it and the steam train were nose to nose, when it started full speed. The steam train, having the advantage of a running start, gained on its rival for awhile, but the speed of the latter accelerated so rapidly that it never got far enough behind for daylight to pass between the rear of the steam train and the nose of the electric locomotive, and in a few minutes the electric train was neck and neck with the steam train, and soon was ahead.

Races such as this between the electric train and passing steam trains became from that time almost daily events. Speeds of eighty-five miles were attained in these races, which covered a total distance of 50,000 miles. It was demonstrated that the experimental electric locomotive with an equal load could both pick up speed much faster than the best steam passenger locomotives and attain higher maximum speeds.

The use of electricity as the motive power of all railroads, unless some better motive power shall be discovered, seems now one of the certainties of the future. The late E. H. Harriman said in an au-

FOURTEEN OF THE ELECTRIC LOCOMOTIVES

thorized interview about three years ago:

"I believe that the railroads will have to come to that [electrification], not only for the purpose of getting a large unit of motive power and of distributing it over the trainload, but on account of fuel. The great saving resulting from the use of electricity is apparent, quite aside from increasing the tractive power and the trainload."

C. S. Mellen, president of this road, the New York, New Haven & Hartford, has said: "Looking ahead a very few years on such portions of our line as that between New York and New Haven I expect to see the steam locomotive become in the nature of a curiosity."

Electrification will not come today or tomorrow. It will be years before it is general in the country. But that it must ultimately come seems now unquestionable. In Chicago it will come, no doubt, as track elevation has come, with the expense distributed over a period of years so that it will not be unduly burdensome to the roads.

No one anticipated the changes that the steam locomotive, in less than a century, has wrought. No one now can foretell what changes the electric motor will cause. But that it will cause some very great changes, and what some of these will be, are probably indicated by what it already has done.

The fastest time regularly made for a long distance by any steam train in this country is that of the Twentieth Century Limited on the New York Central and the Lake Shore. It averages fifty-five miles an hour, including stops, between Chicago and New York. A Lake Shore train ten years ago ran from Chicago to Buffalo, 510 miles, in 470 minutes, an average of 64.72 miles an hour. A train on the Philadelphia & Reading five years ago ran five miles at the rate of over 115 miles an hour, or an average of a mile in thirty-two seconds.

The development of the electric locomotives has but begun, yet the contract for the locomotives used by the New Haven on its New York terminals required that they must be able to run sixty to seventy miles an hour with a 200-ton train; and they have hauled 350-ton trains seventy miles an hour. We have seen that the first electric locomotive for the New York Central made eighty-five miles an hour. The electric

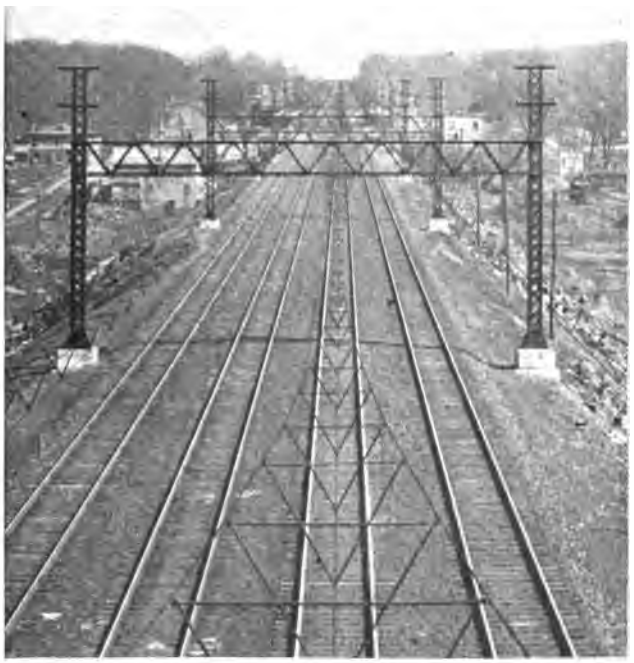
FOR THE NEW YORK CENTRAL LINES

locomotive built for use in the tunnels into the Pennsylvania's new passenger station in New York City has run ninety miles an hour. During the Berlin-Zoessen tests in Germany an electrically propelled train ran at the rate of 130 miles an hour. This speed—averaging a mile every twenty-seven seconds—is the fastest ever made by any machine for any distance in the world. Probably as the electric locomotive is further developed it will attain on the best track a speed that has not yet been approached. One of its most striking characteristics is its ability to maintain almost as fast a pace over mountain grades as on the level.

The tractive power of the steam locomotive rapidly diminishes as its speed increases. The electric locomotive will be able to haul more cars and passengers in a train for two reasons. It has much less of its own dead weight to carry, owing to the elimination of the tender and for other reasons. An Atlantic steam locomotive, with fifty-five tons on its drivers, weighs 160 tons. One of the New York Central's electric locomotives, with 68½ tons on the drivers, and a tractive power as great as an Atlantic, weighs only 94½ tons. Having sixty-five tons less of its own weight to haul, it has that much more power for pulling coaches. Then, the electric locomotive, unlike the steam locomotive, is merely the instrument through which is applied the power of a power-house producing many thousands of horsepower; and therefore it can maintain a high speed for an indefinite time with an approach to disregard of the number of cars it pulls.

The average traveler commonly rides on local trains or on through trains making frequent stops. The average speed of these trains depends largely on the time lost in starting and stopping. An electrically-propelled train, as was shown in the tests above referred to on the New York Central, can be got under full speed much quicker than a steam train of the same number of cars, and can therefore maintain a much higher average speed while making numerous stops.

Reference has been made already to the danger of running steam locomotives through tunnels. This was one of the main causes of the electrification of the New Haven's and the New York Central's terminals in New York, and of the electrification by the Grand Trunk in



A Fine Stretch of Electrified Road on the New York, New Haven & Hartford.

1909 of its Sarnia tunnel, under the St. Clair River. In 1904 a Grand Trunk freight train parted in this tunnel, and six employes who were unable to get out were suffocated by the gases from the engine. There are tunnels in all parts of the United States that can be made safe only by electrification.

In case of a rear end collision the energy that propels the electric train can be shut off instantly, while the steam locomotive, with 1,500 to 2,000 pounds of coal heated to incandescence in its fire box, is apt to set fire to cars or other combustible material. There is always more or less danger of the explosion of the boiler of the steam locomotive, carrying steam at high pressure. Steam trains must be heated by steam conveyed through pipes from the locomotives or by stoves and in case of a wreck passengers are in peril of being scalded or burned. I saw a wreck on the Chicago & Alton, near Marshall, Mo., in 1901, in which twenty-one people were killed and fifty-three injured, all by scalding. No more pitiable sight ever was witnessed. Danger from this source is removed by the use of the electric heater.

The danger of derailment is less under electric than steam operation because of the elimination of the unbalanced reciprocating parts of the steam locomotive, which tend to lift the engine from the track, and of the absence of the hammer blow of the steam locomotive which, especially in cold weather, frequently causes broken rails. Electrification makes possible the installation of the most improved block systems, and does away with the smoke which tends, especially in foggy weather, to obscure signals. The motors on New York Subway cars are so arranged that if the handle controlling the power be released the power is at once cut off the train, and if a motorman should die suddenly, or, in the face of imminent danger, lose his head and drop the handle, his train would be brought quickly to a stand. The Boston Elevated has a device that cuts the power from trains and sets the air-brakes in case two trains get into the same block. The New York, New Haven & Hartford has switches in the signal towers of its New York terminals by which power can be cut off a train that enters a closed block, while on a steam line if a block operator lets two trains get into one block he may be helpless to prevent an accident. By similar means the electric current could be cut off an entire division where the dispatcher foresaw that otherwise there would be a collision, whereas on a steam

road, under these conditions, an accident might not be preventable.

Perhaps it was the irony of fate that just three days after the first electric train pulled out of the Grand Central station, a passenger train drawn by two electric locomotives left the track on a curve near Woodlawn while running sixty miles an hour; the coaches were dragged along the roadbed until they toppled over on their sides; twenty-four passengers were killed and 143 injured.

To find out what was the cause of this accident the same locomotives were again hitched to a train of old cars carrying W. C. Brown, then senior vice-president and now president of the New York Central, and others, and was repeatedly driven over the same track by the same motorman at sixty miles an hour; but no accident resulted, and to this day the cause of the wreck is not known. As no other serious accident has happened on electrified lines, this one has about ceased to be charged against electrification.

There are some dangers peculiar to electric transportation, owing to the presence of an electric conductor conveying power. These dangers are especially great where the conductor is an exposed third rail. But the experience of the New York Central and other lines has shown that the third rail may be so protected as to be a source of little or no danger to either employes or travelers.

People living in the country and in towns have little idea of the public sentiment that the smoke nuisance in such cities as Cleveland, Pittsburg and Chicago has created in favor of electrification of railroad terminals. Chicago is the largest railroad center in the world. About 1,500 trains enter and depart from it daily. Yet it is stated there are only about 600 locomotives in the city, as compared with 11,000 stationary power plants; and, according to a city commission that recently investigated the subject, the railroads use only thirteen per cent of the coal burned in Chicago and produce only ten per cent of the smoke.

But the public has a right to demand that the smoke nuisance in cities be abated as far as practicable; and that railroads shall do their part. Now it is stated by those who have investigated the subject that the abatement of smoke from stationary plants burning bituminous coal is practicable through the installation of suitable boilers and furnaces and the exercise of care in firing; but it appears that to prevent a steam loco-

ELECTRIC ZONES, HARLEM DIVISION, NEW YORK CENTRAL RAILROAD.

motive burning bituminous coal from smoking badly often is impracticable. Electrification would reduce the nuisance of smoke from locomotives in three ways. Coal, after electrification, would still be burned in power houses; but it is estimated by eminent authorities that if all the railroads of the United States were electrified the power required by them now could be produced by the burning in power houses of one-half of the coal burned in locomotives at present. In a large power house the firing of the furnaces could be so done as to reduce to the possible minimum the smoke from the reduced amount of coal that was burned. The power houses would be situated remote from residence and business districts, and the gas and smoke from their smoke stacks would be discharged high into the air. The Illinois Central, for the electrification of whose terminals in Chicago there has recently been a great deal of agitation, has begun burning coke in Chicago to abate the part of the smoke nuisance for which it is responsible.

Physicians say that the smoke and gas in the atmosphere of many cities injure the health of many thousands of people. They make it hard to keep the person clean and largely increase laundry bills. They cause heavy damage to goods in stores and the furnishings of homes. By killing the vegetation along drives and in parks, and blackening the walls of buildings, they defeat the proper ambition that has developed in so many places in recent years to beautify American cities. Electrification of railroad terminals alone will not go far toward making Pittsburg or Chicago as clean or beautiful as New York—where no bituminous coal is burned—Paris and others of the world's show places; but as a part of a general scheme for suppressing the smoke nuisance it will do its part toward this end. It would, however, be plainly and grossly unfair for the public to require the railroads to abolish at heavy expense, the relatively small part of the smoke nuisance for which they are responsible before manufacturers, owners of office buildings, etc., shall have been compelled to abolish, at relatively small expense, the large part of the nuisance for which they are responsible.

Electrification will greatly increase the comfort and pleasure of travel. Who has not had the enjoyment of a railroad trip—along the Hudson, or over the Rockies, perhaps—marred by smoke, soot and cinders from the locomotive, obscuring scenery, soiling person and

CIRCUS EN ROUTE FROM PALOUSE, WASH., TO SPOKANE, SEVENTY-SIX MILES AWAY, OVER ELECTRIC ROAD.

clothes and filling nostrils and eyes?

Electrification will serve the convenience as well as the comfort of travelers. It is believed it will increase the reliability of train service. Statistics of the Manhattan Elevated for November, 1900, to March, 1901, under steam operation, and for November, 1905, to March, 1906, under electrical operation, show that, under electrical operation, the number of cars per train and the scheduled speed of trains were both increased, while the number of late trains was reduced fifty per cent. Whatever tends not only to increase the average speed of passenger trains, but also to reduce the number that are late, will be welcomed by the traveling public.

MAIN FREIGHT YARDS OF THE INLAND EMPIRE ELECTRIC SYSTEM AT SPOKANE.
They are located between the five transcontinental steam lines and connect with each by transfer track.

One of the marked advantages of electric over steam operation is its flexibility. It costs about as much to run a steam engine with one car hitched to it as to run it with three or four; and therefore the cost of running frequent steam passenger trains except where the traffic is very dense is prohibitive. On electric lines the expense for power is about the same whether a single motor car is run every fifteen minutes or a four-car train is run every hour. The more rapid acceleration of trains under electric operation also enables them to maintain a high average speed while making numerous stops. Electrification of steam roads will therefore subserve the convenience of the traveling public by giving it both more frequent train service and more stations where trains can be boarded.

Freight traffic became badly congested in 1906 and 1907 because we had outgrown the facilities for handling it. The late Mr. Harriman said that electrification was the remedy for this situation. His great rival, James J. Hill, is making a practical trial of this remedy by electrifying the Cascade tunnel of the Great Northern in Washington. This single track tunnel is 14,400 feet long and is 240 feet higher at the eastern than at the western end. Its maximum capacity for handling freight by steam had been reached, despite the use of the most powerful locomotives built and the longest trains practicable under steam operation, and no more traffic could be got over the road than could be got through the tunnel. It was expected that the electric locomotives would be able to pull heavier trains and—owing to their greater capacity for maintaining speed on steep grades and the smaller headway under which they can be run—more of them, thus relieving the congestion on the whole lines.

Recently the Spokane & Inland Empire, an electric road in Washington, demonstrated the capacity of its electric locomotives to pull heavy freight trains by hauling the long Floto-Sells circus train along its line—the first time a circus outfit ever was hauled by electric traction. The Grand Trunk is pulling heavy freight trains by electricity through its tunnel under the St. Clair River at Sarnia, Canada, which is the longest submarine tunnel in this country.

The length of a freight train hauled by a single steam locomotive is limited by the strength of the draft gear, and steam locomotives cannot be distributed to very good advantage throughout a long train because no means is available for controlling their effort simultaneously, although the Harriman lines sometimes use four steam locomotives to pull a single freight train over the mountains.

SPEED TEST BETWEEN AN ELECTRIC AND A NEW YORK CENTRAL STEAM LOCOMOTIVE.
The electric locomotive distanced the world's famous Empire State Express.

If freight cars were equipped with control-wiring and control-couplers, numerous electric locomotives all operated by a single engineman by multiple-unit control, could, the advocates of electrification say, be distributed throughout a train; and freight trains far longer than any now known could be satisfactorily operated. Furthermore, the electric locomotive can exert its maximum tractive power at a speed of thirty miles an hour, while the largest steam locomotives cannot develop their maximum tractive power at more than ten miles an hour. The extent to which longer freight trains run at so much higher speeds would increase the amount of business that could be handled on existing tracks is obvious. However, electric locomotives until recently were used in heavy freight service only for pulling trains through tunnels. The Westinghouse Company have made some electric locomotives for freight service on the New Haven between New York City and Stamford, Conn.

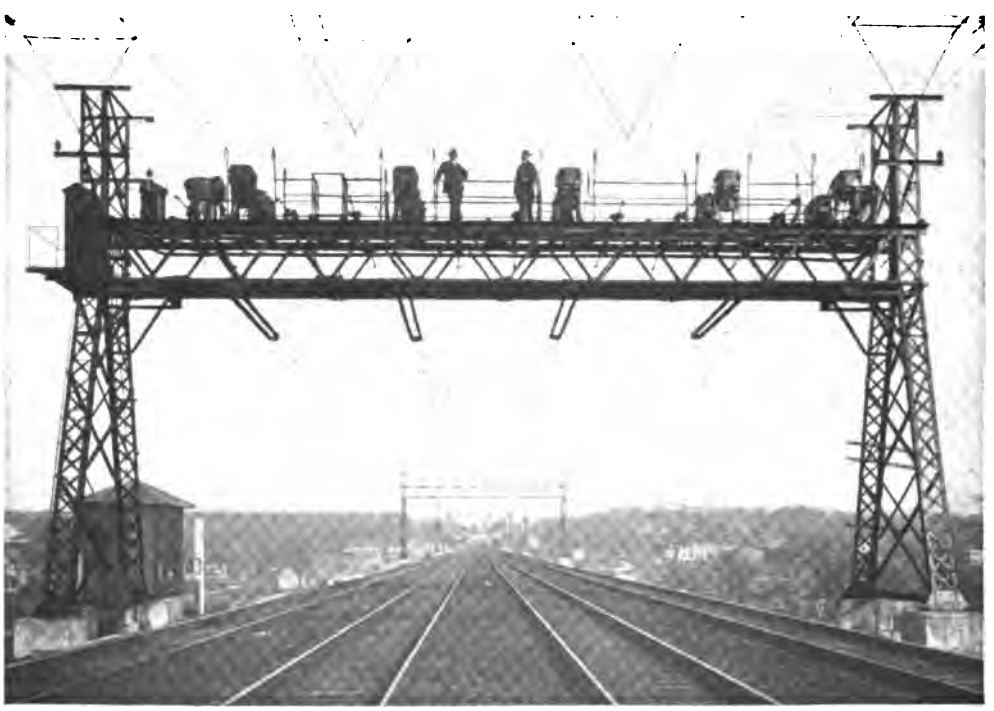
Electrification would make it practicable to furnish more frequent freight service, for the same reasons that it would make it practicable to furnish more frequent passenger service. The amount of this so-called "package" business that could be built up by the railroads by operating freight cars equipped with electric motors that could be run singly or in trains undoubtedly would be very large in populous parts of the country.

The steam railroads of the United States employ over 1,600,000 men. It is an interesting and important question what effect electrification would have on them. Primarily, it would reduce the number of enginemen, both because it is estimated that one electric locomotive could do the work of two steam locomotives, and because one man instead of two would be required to run each engine. It would reduce the number of men required to repair locomotives. In proportion as it increased the length of trains, it would reduce the number of trainmen needed. By promoting the use of automatic electric signal systems it would tend to eliminate block system operators. On the other hand, employment for a good many men would be created in power houses, and in proportion as more frequent passenger and freight service was afforded the number of trainmen required would be increased. Here, as elsewhere, the introduction of improved machinery might work a temporary disadvantage to labor, but in the long run would probably cause more men to be employed at equal or higher wages.

There are about 45,000 miles of electric interurban and street railways in the United States. Most of them do only a local passenger business, although some handle through passenger and freight business. A correspondent for one of the

Chicago newspapers some time ago made a trip almost entirely by trolley from Chicago to New York. If we may judge by past experience, electrification of steam roads would be accompanied by the rapid absorption by them of the interurban, and even of the street railway lines. On its Nantasket Beach line the New York, New Haven & Hartford made in 1894 the first electric installation by a steam road in this country. It has since extended electricity to a number of other lines, including its terminals in New York City. Meantime, it has got control of a large mileage of interurban lines and street railways, both to rid itself of their competition and for use as feeders. C. S. Mellen, president of the New Haven, has indicated that it is his purpose to electrify other steam lines of the New Haven, and to connect these and the controlled interurban lines with street railways, so that a through passenger returning, say, from the South or West, to his home in Boston, perhaps, or New Haven, can be set down at the door of his own house without changing cars. This suggests that the time may come when the farmer in Missouri or Kansas can load his wheat or cattle on a freight car in his barnyard and ship it in the same car directly to the stockyards in Kansas City or Chicago.

The question regarding electrification that is uppermost in the minds of the managements of steam roads is whether it will pay. It has been estimated that it would cost an average of $7,050 per mile to electrify all the steam railroads of the United States, or, on the basis of the mileage on June 30, 1907,—230,000 miles—about $1,620,000,000. Lewis B. Stillwell and Henry St. Clair Putnam have estimated that the reduction in operating expenses would be eighteen per cent, or, on the basis of the expenses in 1907, about $315,000,000 annually. It has been estimated that the saving on coal would be fifty per cent, or, on this single item, $90,000,000 to $100,000,000 annually. If these figures were unquestionably correct they would demonstrate that the railroads could make no more profitable investment than in electrification. But the estimates given have been severely criticised. Some experts have



THE OVER-HEAD WIRE SYSTEM ON THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD.

THE APPROACH TO THE ST. CLAIR RIVER TUNNEL ON THE GRAND TRUNK.

contended that the reduction in operating expenses would not be more than five, or perhaps only three per cent, which would not pay interest on the investment. It is also contended that the cost of electrification would be much larger than its advocates have estimated.

The question of whether electrification will pay is not, however, merely a question of how much it will cost and how much it will reduce present operating expenses. Owing to the rapid growth of traffic there must be within the next few years a great increase in transportation facilities, so the real question to be settled is whether a large share of the capital can be more economically invested in electrification, or whether it shall all be spent in buying new steam equipment and in building the additional tracks that steam operation will require.

There is still another important phase of the problem. Because of the greater comfort, frequency and convenience of the service afforded, electric operation always creates new traffic; and electric interurban roads not only build up new business, but for hauls of ten miles or less attract from the steam roads from 75 to 90 per cent of their local business. In 1895 the Lake Shore & Michigan Southern carried 203,000 passengers between Cleveland and Oberlin and intermediate points. The Cleveland, Elyria & Western, an electric line, was built, and in 1902 the steam road hauled only 91,761 passengers, while the electric road carried 3,000,000. In 1895 the Nickel Plate carried 42,526 passengers between Cleveland and Lorain and intermediate points. In 1902 the Nickel Plate carried less than 10,000 passengers between these points, and the Lake Shore, a new electric line, carried 3,896,902. If the electric lines are consolidated into trunk lines they will become severe competitors for through as well as local business. On the other hand, if the steam roads shall electrify they will get the benefit of the increase in business and will not have their business attracted from them. The interurban roads probably would then become merely feeders of the steam roads.

PREDICTING NATURE'S EXPLOSIONS

By

RALPH BERGENGREN

DURING the past decade an average of about one hundred persons a day have been killed by earthquakes, floods, and volcanoes. The list of catastrophes includes those at Guatemala, Martinique, St. Vincent, Galveston, San Francisco, Valparaiso, Jamaica, Kartaghan, India, Calabria, and Messina. In other words these awe-inspiring outbursts of nature are actually so common that several of the destructive calamities of the last ten years are already forgotten by the general public. Unless the destroying force happens in the next decade to sweep away some large and important center of modern life many other calamities will add their quota to the historic death list of over thirteen million human beings and attract only the casual mention of a newspaper headline, possibly not even in an important part of the paper. Many—thousands and thousands when we include the little ones—will occur altogether unnoticed except by the immediate sufferers.

Startling as all this sounds, even the earthquake and the volcano is really quite a matter-of-course episode in the continuous history of the earth we live on. Volcanic eruption, flood, or earthquake—no part of its surface is immune to all of them. In the opinion of scientific observers the list of recent calamities might almost as easily have included Boston, New York, or London as San Francisco, Messina, and Paris. But the very knowledge that suggests this start-

LOOKING INTO IT.
An American volcanologist on the edge of Etna's main crater.

AFTER THE EARTHQUAKE AT MESSINA.
Showing how the frame of a building sometimes remains standing after the facade has been shaken away.

ling possibility suggests at the same time a hardly less surprising escape from many of its worst aspects,—namely, that every important upheaval could be predicted with sufficient accuracy practically to eliminate the loss of life, and could be prepared for by the erection of buildings that would be practically proof against the shock of an earthquake and by the working out of engineering problems whose solution would control and direct the lava flow of an erupting volcano. Man, in short, will never be able to prevent such upheavals, but it is at least well within the limit of possibilities that he will be able to predict their coming and greatly lessen their effects upon human life and property. Granting that the study of these phenomena, in the modern sense of detailed, minute, and long continued investigation, is still in its infancy, it is already established that volcanoes give warning of their eruptions and that buildings may be erected that will survive earthquakes. Soufrière gave such indications fully a year before its destructive outbreak. A large proportion of the forty thousand persons immolated by Mont Pelèe might have escaped if they had heeded the advice of scientists who predicted the eruption. In the case of a preliminary eruption of Mt. Etna in 1908 Mr. Frank Alvord Perret, an American vol-

STUDYING THE HEAT OF GASES IN A DYING OR DORMANT VOLCANIC TERRITORY.

canologist, had so accurately scheduled the eruption that he was able to arrive at the crater, very much as if he had made an appointment, just in time to photograph the beginning of the upheaval before he was compelled to save himself and his negatives by flight to a safer location.

This study of earth movements is literally a new science, already sufficiently established to claim its place among the others, but still too young to have attracted the many million dollar investments that would be needed to provide equipment and workers for a comparative study of the entire world surface. As defined recently by Professor T. A. Jaggar, a volcanologist who is also head of the department of geology in the Massachusetts Institute of Technology, it "is not truly either geology or geography, but a department which might well be given the name of geonomy, or earth knowledge." It deals, in short, not with the secrets of the past as revealed by historical geology, but with the living processes of the immediate present. To place it on a working basis would require a chain of observatories including New York, Porto Rico, the Canal Zone, Alaska, the Aleutian Islands, the Philippines, Hawaii, Scotland, and Sicily. Such a chain of observatories would complete for

AN INVESTIGATOR OF NATURE'S EXPLOSIONS.
Prof. Thomas A. Jaggar, Jr., Massachusetts Institute of Technology.

FALLEN COLUMNS AT MESSINA.
These columns were thrown from north-east to south-west, while other structures in the neighborhood fell toward other points of the compass.

HOW NOT TO BUILD IN EARTHQUAKE TERRITORY.
Japanese engineers could have built this Sicilian house so that it would have been practically uninjured.

the earth as a whole what Japan has already done for her own island empire. It would co-operate in the studies now going forward in Japan with the object of reducing earthquake prediction to an exact science. It would also undoubtedly lead to a wider adoption of the principles of building construction that Japanese engineers have already successfully applied to earthquake territory.

Outside of Japan the work is still entirely in the hands of individual investigators supported either by the geological department of an occasional university or by such individual aid as that represented by the Volcanic Research Society of Springfield, Mass., where a group of public spirited citizens have combined to finance Mr. Perret's remarkable series of investigations. Both in this country and Europe, however, a wider interest is becoming manifest. The governments of the world are at least taking the matter into consideration. In this country both the American Philosophical Society and the Geological Society of America are endeavoring to interest government and private enterprise with a view to obtaining a foundation that will eventually treat earthquake and volcanic phenomena with the same scientific accuracy that makes the work of the meteorological bureau a constant saving of what would be the incalculable expense of unpredicted blizzards, tornadoes, and other natural phenomena that the world not so very long ago considered quite as much beyond the possibility of systematic prediction.

Misleading as it is to think of the earth as "solid," the idea is so natural that science today presents the curious condition of knowing more about the movements of the stars in their courses than about the movements of the earth under our feet. We are more interested in the possibility that on the planet Mars a population of "thinking organisms" is actively at work combating its own extinction by the natural processes of that planet than in the possibility of combating at home the destructive processes of the planet on which we live. Unwittingly, as in the denudation of our forests and perhaps even at the present moment in our engineering activity in the seismic, or earthquake, region of the Canal Zone, we are often busily at work aiding these destructive processes to pile up future trouble for our descendants. But we have at least determined that nature, from stars to bacteria, is governed by discoverable laws, by whose study it is possible for a man to predict the course of coming events, and it is apparently be-

yond the bounds of reason that the movements of the "solid earth" are not conducted according to laws equally uniform and equally amenable to human codification. Meantime we can no longer comfort ourselves with the false notion that such upheavals as the earthquake or volcano are sporadic; nor safely forget, because it is only once in a considerable time that a large city is suddenly wiped out of existence, that smaller places are being wiped out with calm and inevitable regularity. It is the growth of the large city that emphasizes the need of precautionary measures. And the fact is also beginning to be realized that the actual expense of developing a science of prediction and amelioration would at most be a mere drop in the bucket compared with the vital and industrial losses that result from a single great calamity, to say nothing of increased insurance and the tremendous expense of rebuilding a demolished city.

Little as is actually known about the processes of the earth, there are four general groups of activities that are just as constantly in motion today as they were in the prehistoric periods—erosion, sedimentation, deformation, and eruption. Any one of these is capable of producing disaster, for the earth labors without the slightest consideration for whatever human beings, their families or cities may be in the way of its operations. Until this planet becomes dead like the moon these activities must continue and perhaps the most generally accepted theory is that they depend fundamentally on the cooling of the interior of the earth and the inevitable struggle of the outer crust to adapt itself to a decreasing inside body. It is, one might say, like a fat man growing too small for his overcoat: the outer covering wrinkles, and as the outer covering of the earth is a crust some thirty or forty miles thick a great many things happen that produce the remarkable consequences that we cheerfully class together as physical geography. More than that the action of the earth's surface is influenced by the gravitational pull of the sun and moon according as they are more or less distant.

One may theorize indefinitely. The fact, altogether untheoretical, remains that the earth is an active body, that in certain places its activities are open to the investigation of any man brave enough and skillful enough to undertake it, and that the opportunity for daring, devil-may-care adventure in this newly opened field of science is quite in proportion to the immense good to humanity that a growing number of keenly intelligent and scientifically able men believe would come out of it. Man at present

TIME OF THE MESSINA EARTHQUAKE RECORDED BY THE STOPPING OF A HOTEL CLOCK.

knows practically nothing of the actual condition of things a few miles under his feet; nor, despite the sensational suggestions that have been made in that direction, is it at all practicable for him to bore a hole in the surface deep enough to provide useful information. Nature, in fact, has already bored such holes for us in every active volcanic region and we have so far taken practically no advantage whatever of these living laboratories in which the processes of earth building are in actual operation. We have, it is true, tried to look down the craters of volcanoes, and Empedocles, who first taught that the interior of the earth is of molten matter rather than fire, is traditionally supposed to have tumbled into Etna some four hundred and twenty-three years before the beginning of the Christian Era. But it is only within the last half century that it has occurred to us that a scientific analysis of the gases and other products that come out of the crater would in the long run afford information about the interior of the earth in the same manner that chemistry applied to the light of the stars has afforded a still increasing volume of knowledge about the composition of the solar system. To collect, item by item and year by year, the facts that chemical and physical science would bring to light if applied to conditions at the various openings in the earth surface of a volcanic region is therefore one of the first problems of geonomy—a problem whose possibilities have already been splendidly indicated by Mr. Perret, although he has no adequate laboratory to work in and must make his studies entirely with field instruments. And to deduce from this accumulated data the science of prediction that shall make human life and property safer is the great utilitarian purpose. Incidentally there are yet other possibilities: that the investigation of conditions at the very heart of the earth's volcanic activity, where the primary forces of nature are still in action, may reveal new

WHERE THE SOLID EARTH MOVED LIKE THE OCEAN.
After the Messina earthquake the detached curbstones of a city street preserved this record of the wavelike motion of the earth during the shocks.

sources of usable power or new facts concerning the beginnings of evolution.

The possibility and value of preparing for an unavoidable catastrophe was strikingly illustrated a few years ago in the breaking of the Gohna Dam in Northern India. In this case the starting point, so far as human observation could see it, was a landslip in one of the narrow gorges of the Himalayas through which the Birieh Ganga river flows to join the Ganges. The landslip occurred just above Gohna, a small village some hundred and fifty miles above the ancient city of Hardwar, much frequented by Hindoo pilgrims. Other villages occur here and there along the stream between Hardwar and Gohna: the narrow road has always its bands of pilgrims; and the river is frequently crossed by bridges erected by the British government to facilitate travel. To close this road, almost unknown to Europeans, would be at any time a serious hardship to the Hindoos, and at Hardwar is located the head of the irrigating system that distributes the water of the Ganges over a considerable tract of northern India. A flood in this part of India could have done enormous damage and yet have been hardly noticed, perhaps not even heard of, by the average American.

OBSERVATORY ON MOUNT ETNA.
This building, erected for the study of volcanic conditions, is of little practical value owing to lack of funds and equipment.

In the autumn of 1895 it was reported to the British government in India that a landslip had occurred just above Gohna, had dammed the river, and that a lake was accumulating. Government experts were sent to Gohna, the situation examined, the strength of the dam and the rate of rise in the lake calculated, and the suggestion adopted that instead of attempting the doubtful and expensive expedient of tunneling the dam and drawing off the water, the lake should be allowed to overflow and the country below be prepared for the disaster. A telegraph line was established along the one hundred and fifty miles of valley. The danger zone was estimated and marked by cairns on which lights burned at night. Bridges were taken down and replaced by temporary structures. The headquarters of the irrigating system at Hardwar were strengthened and made ready for the flood. Otherwise the daily life of the valley went on as usual.

Within ten days of the time predicted, 16,000,000,000 cubic feet of water topped the dam and swept down a slope of two hundred and fifty feet to the mile, carrying everything before it and doing immense damage which was nevertheless a mere fraction of what would have happened had the flood broken over unexpecting villages and unwarned travelers. Not a single life was sacrificed, and the work of restoration was reduced to a minimum. The total expense to the British government was probably not more than $75,000 and the episode illustrates on a comparatively small scale what the modern geologist believes will be done eventually in any part of the globe threatened by a natural catastrophe.

Meantime so far as concern earthquake phenomena the Japanese, startled into the practical study of the matter by their own disastrous earthquakes, are the only people who are taking the matter with the national seriousness that it actually warrants. The modern seismograph—the instrument that permanently records the movements of the earth during a

quake—is a Japanese invention whose adoption may be fairly said to mark the real beginning of seismology as a scientific study. The whole series of studies looking toward earthquake-proof buildings has been carried on in that country. There, for example, was evolved the "shaking table," a platform which can be made to repeat the characteristic movements of the earth surface during an earthquake shock and on which the Japanese have carried out their experiments to find the kinds of buildings best adapted to go through an earthquake and remain standing at the end of it. On their "shaking tables" Japanese engineers have erected various structures and then shaken them to pieces, taking seismographic records of the movements of this miniature earth and noting the behavior of their miniature buildings under all the different conditions. From these experiments, combined with the data obtained from the ruins of real earthquakes, they have established the limit of stable height for masonry walls and have discovered also that a wall whose outer surface is built in parabolic curves will resist earthquake disturbance. They have devised systems of safe construction for frame dwellings and have gone far in applying these principles, whose excellence is now recognized by students of earthquake engineering the world over, to their own railways, bridges, and aqueducts. Whatever else may happen it is the belief of our own seismologists that the future study of earthquake phenomena must inevitably follow the lines laid down by these Japanese scientists and engineers; and that their precautionary measures should be now adapted to our own building operations in such parts of our own country as are most liable to earthquakes.

In this country, however, we are so far not even provided with a sufficient number of seismographs in operation to make the study of their records much more than preliminary practice for real seismology and volcanology. The continual movements, vertical and horizontal, of the earth's surface; the relation between these movements and the changes in temperature, barometric pressure, electric and astronomical conditions and observed volcanic and seismic outbursts in other parts of the world are not yet being systematically studied. The work of individuals—Professor Jaggar, for example, at the Institute of Technology, Professor Hobbs at the University of Michigan, Professor Woodworth at Harvard, Professor Tarr at Cornell, Professor Lawson at the University of California, and Dr. Gilbert of the United States Geological Survey—is the splendid pioneer work such as has usually preceded the establishment of any new department of science. Broadly speaking, the same condition obtains in Europe.

Yet we have one especially large and striking example of the need of such investigation. In the Canal Zone hundreds of millions of dollars are being expended to unite two oceans by a great cut in the earth's surface comparable to the lines on Mars from which Professor Percival Lowell deduces human activity on that planet. From the point of view of physical geology it is considered extremely probable that the crust of the earth is at this point subject to stresses of unknown intensity which an adequate development of the study of earth conditions should enable us to determine and measure. Here is knowledge that should be at the service of the engineers who are directing the work of the canal, yet we are unfortunately so ignorant of these forces, except in the knowledge that they exist and in the conviction that they will sooner or later be adequately studied, that the engineering work of the canal must necessarily go forward without this important assistance.

So in the recent flood at Paris, although the flood could not have been prevented, the expense of preparing for it and of minimizing its results would have been almost negligable in comparison with the vast sums that are now being expended in restoring normal conditions.

Meantime there is a practical certainty that within a few years a well equipped and financed observatory will be established under the direction of Professor Jaggar near the active crater of Kilaeua in Hawaii. The observatory will be financed by combined Boston and Hawaiian capital working in co-operation with the Massachusetts Institute of Technology.

The PLACE of the PASSION PLAY

THE AMMER RIVER AND PASSIONE THEATRE.

IN THE VILLAGE STREETS.

THE CRUCIFIXION GROUP.

OBERAMMERGAU LYING IN THE VALLEY.

One Reason Why Living Is High

By Rube Borough

THE work of the newly created bureau of weights and measures in Milwaukee has resulted in some startling revelations with reference to the prevailing conditions of the morals of the retail merchants of a great city. At the time of writing city sealer Fred C. Jansen, and deputy sealers W. F. Steinel and George Phillips have been at the actual work of inspecting weights and measures a little over two and a half months, and in this period have found it necessary to condemn and confiscate over 2,000 dishonest weighing and measuring devices. The accompanying photograph shows, according to Deputy Sealer Steinel, the largest collection of confiscated weighing and measuring devices ever made by an American city.

"We have not been able as yet," said First Deputy Steinel, "to pay much attention to the city markets, the commission houses, nor to the ice, coal and milk supply. So far we have confined our work principally to the grocers and butchers."

The Bureau's report for the month of April shows that out of a total of 263 places visited, all the scales and measuring devices were given the official O. K. in only sixty-three stores. This report would seem to indicate that seventy-six per cent. of the merchants visited were either careless in some of their methods of doing business or dishonest. The number of actual scales inspected in the 263 places during this month was 879. Of these, 130 were condemned and 168 adjusted. The per cent. of scales bad was thus 33 9/10. The number of measures inspected was 1,893, of which 451 were condemned. The per cent. bad here was 23 3/10.

According to Deputy Steinel, there are about 5,000 grocers and butchers in Milwaukee. If these establishments average a business of even twenty-five to fifty dollars a day, the aggregate daily purchases of the people must run up into the hundreds of thousands of dollars. It thus appears probable that the people in the past have been robbed annually of many thousands of dollars in buying the bare necessities of life. Dishonesty certainly does not make for low prices.

STEEL TAKES A NEW FIELD

By

HARTLEY M. PHELPS

THE manufacture of sheet steel piling is fast becoming an important industry in the United States. And in this statement the friends of forest conservation may find a huge grain of comfort, for the modern metal pile has almost superseded the wooden sheeting in all forms of permanent and temporary building and engineering work.

But perhaps the man on the street has but a vague idea of what this steel piling is. To clarify his mind in this respect it need only be explained that it consists simply of sections of sheet steel each one having an interlocking device so that it may be driven into the earth by a steam hammer or with a maul, wielded by hand, the piling thus forming a steel wall. The primary uses of piling are to hold up earth from caving in, and to prevent water from entering excavations. For the construction of coffer-dams the new piles are invaluable as the subaqueous contractor must have a set of tools that can be easily carried from place to place and used over and over again: conditions perfectly met by the metal pile as it can be pulled and driven repeatedly. In fact it is on record that steel piles have been re-drawn and used as many as eighty times.

The new sheeting is cheaper than wood, first, because it can be rolled in the mill and therefore placed on the open market in standard shapes and sizes, procurable at reasonable prices; and, second, for its greater strength and capability of repeated use. To be satisfactory, it must show sufficient strength to withstand lateral pressure of earth and water, possess a large radius of gyration, be easy to withdraw, and be reasonably water-tight. One of its

COFFERDAM FOR BRIDGE ON THE BALTIMORE & OHIO RAILROAD AT CLEVELAND.
Sheet steel piling was used in its construction.

greatest advantages is that it is proof against corrosion in water, a very important consideration in this class of work. It may be cut by hand with a hack-saw or by means of the oxy-acetylene blow-pipe which melts the metal along any desired line.

The principal uses of piling are: for the construction of buildings, especially large ones; for sub-aqueous work such as locks, dams, piers, reservoirs and coffer-dams; for sea-walls and loading slips, retaining walls, building caissons, core and curtain walls, in dams, circular construction, mine shafts, trench, sewer and similar work.

The first use of the modern steel pile for coffer-dam construction in this country was in 1901, when the piers of the Randolph Street bridge at Chicago were built. August Simon of Germany produced the first form of steel pile in 1891 as a result of the futility of attempting to use wooden sheeting and masonry tubes in the 122 foot shaft of the New Hope Coal Mine, in Magdeburg, Germany, where the great need was to seal against water. Although Simon was the original inventor of the steel pile it remained for American engineers to bring it to its present perfected state. It may be stated also, that the people of Chicago, ever in the forefront in the field of engineering science, witnessed in 1899 the driving of the first steel pile in the United States.

It is said the first successful use of steel piles in large building operations was at the A. A. Pope building, Cleveland, Ohio, in 1908, where piles thirty-five feet long were driven, wooden piling not proving available and a pneumatic caisson being too costly. Other notable examples of the use of piling along this line were in putting up the permanent walls of the New Brevoort Hotel, Chicago; the Tribune building and the new Hoffman House, New York, and the old Custom House in Wall Street, New York, when it was turned into quarters for the National City Bank. The Marshall Field warehouse at Chicago had building caissons of steel piling, the foundations of the huge structure passing through river silt and quicksand.

One of the largest and most important sub-aqueous works in the United States was the building of the giant ship-lock of concrete, 817 by 70 feet at Black Rock Harbor, Buffalo, New York, where the government used 7,000 tons of piling. Much steel is likewise used by the government in reclamation projects, among which may be mentioned the gigantic work now being carried out in the

A Giant Ship-Lock Constructed of Concrete and Sheet Steel Piling.

Permanent Sewer Discharge Made of Sheet Steel Piling. Waukegan, Illinois.

FOUNDATIONS OF STEEL PILING.

Big Wood river district of southern Idaho, north of the famous Twin Falls country, where 200 tons of piling were driven on the axis of the great dam to cut off any flow of water under it. This vast irrigation project is unique in that the entire flow of the Big Wood river was diverted through a tunnel, the ordinary coffer-dam or pneumatic-caisson construction being impracticable. The piles, it may be added, showed no appreciable injury after the driving by the steam hammer. These piles are of the I-beam form and the shape was invented by J. J. Harold, of Jersey City. After being repeatedly driven, the twelve and fifteen inch I-beams can be used in temporary or permanent building, bridge and other work.

For mine and elevator shaft construction steel piling is of the greatest value, especially where sunk to rock through quicksand as at New Biggen, England, where the longest steel piles ever driven —eighty-five feet—were forced through clay, running sand and water, and sandstone.

Of late years steel piles have taken the place of most other materials for their purpose. Burrowing animals cannot perforate this wall of metal as they can perforate wood. Steel piling is used much in circular construction, the flexibility of the units making this possible and it is also used to form molds for foundry castings. In trench work it may be driven by hand with a maul, thus saving much expense.

Making the Cactus Pay

by S. R. Mitchell

WHAT use has cactus, the horrid, ugly, thorny inhabitant of the mesa lands and mountain sides of Texas, New Mexico, Arizona and Old Mexico?

Varying in shape, size, color of blossoms and fruits, and length of spines, each variety is as particular about its conditions for proper growth, regarding heat, moisture and elevation as most any plant would be. There are the barrel-shaped, slender cane, cucumber, ball shaped, tree formation, and other merging shapes. The sizes vary from that of a base ball in one kind to that of a large peach tree in another kind, including the barrel cactus, which suggests its own description, and the cane cactus, from which ordinary perforated canes are made. Blossoms mostly red or yellow predominate, while the heavily seeded fruits are all shades of red, yellow and orange, varying in size from that of a peanut to that of the largest lemon, having flavors from an insipid to a mild sweet fruitish taste. An infinite number of spines, varying in length from almost nothing to more than an inch, are found sometimes in bunches, and again scattered all over both the stems and leaves, and on the fruits. These spines are said to be a natural protection against the ravages of the jack rabbit and other animals which eat the growing plants and fruits.

Primarily the cattle man and the goat man noticed that his cattle and goats were eating the cactus, either the cane variety or the prickly pear. This was noticeable more during the dry season than at other times. An investigation showed that some varieties acted as reservoirs and held at certain seasons of the year as much as eighty-five to ninety per cent of water, thus furnishing not only a roughage for the stock, but in many cases saving many head of cattle from perishing by thirst. The stock seemed to like the taste of the cactus better the more they ate, but when the idea of burning off the spines with a gasoline

torch occurred to the cattleman, he found that this removal of spines pleased the beasts so much that he was forced to employ a man in the field a great part of each day, thus providing a food which the cattle seemed to relish. It is known that in order to soften the spines, cactus has been simply chopped fine and allowed to stand for a while, when the spines are softened by the juice; another method is to boil the chopped mass, and this method is probably more efficient. Poultices have often been used consisting of cactus mush. When eaten in large quantities alone the effect of the cactus on the cattle is laxative. After several investigations made by Texas ranchers and dairymen, in co-operation with the department of agriculture, bureau of plant industry, of Washington, and with the New Mexico experiment station, it was learned that cactus increases the flow of milk and induces a more complete digestion, when fed with some other more concentrated food, such as cotton-seed meal and wheat bran.

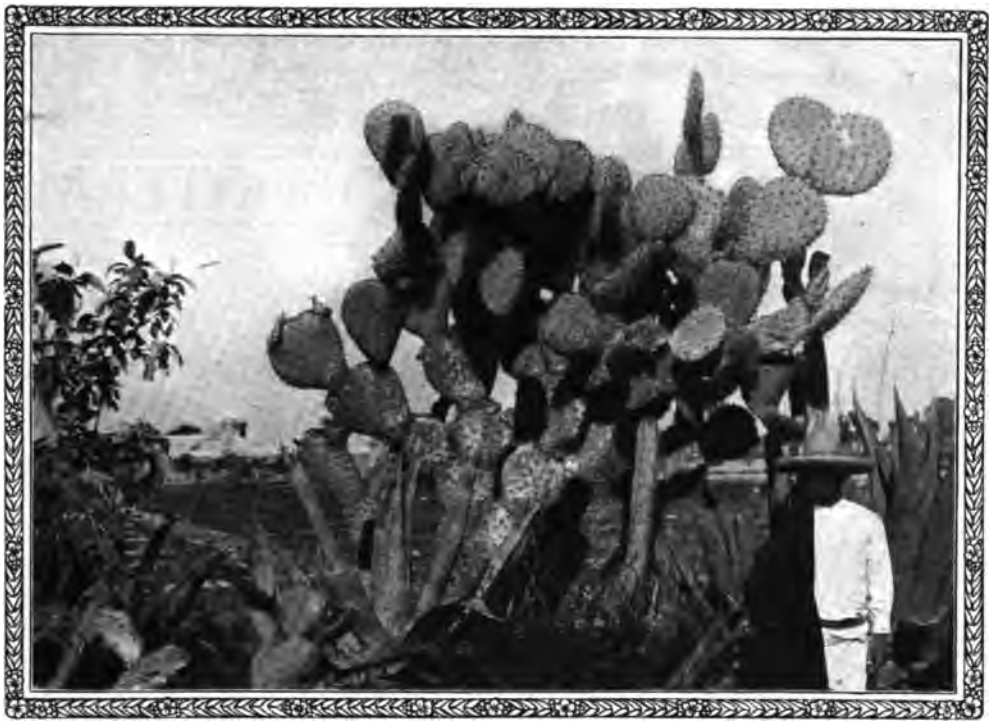
During the past five years the chemical department of the New Mexico government experiment station either alone or in co-operation with the above named parties and others, has devoted a great deal of time to the study of the cactus. Analyses of many varieties of parts of stems and leaves, of whole stems and leaves, of young and old plants, and of the fruits at different stages of growth and under different climatic conditions were made. As a result of these analyses, and from other observations and experiments, a few interesting facts have been evolved for consideration by the technical world. The pressed plant juice, or green, slimy, mucilaginous material obtained from the leaves of the prickly pear cactus is at present being investigated regarding its use in the paper sizing industry. From preliminary experiments it would appear that in the near future the slimy pest will be quite a valuable adjunct to this industry. After pressing out the slime, the solid material remaining, called "press cake," can be dried and utilized as a cattle food, or possibly as a good fuel.

A TUNA GARDEN IN SAN LUIS, POTOSI, MEXICO.

GATHERING TUNAS. THIS FRUIT IS SOLD AT A CENT APIECE.

Probably more progress has been made with the study of the fruits than with the stem and leaves. These little red fruits were fermented and produced five per

SELLING THE TUNA IN OPEN MARKET, MEXICO.



CACTUS THAT CATTLE CAN FEED ON.

cent of pure alcohol. The yield per acre when cultivated was ten tons of fruit. If these fruits could be harvested quickly they would be more valuable than corn as a source of denatured alcohol. But on account of the crowded growth all around the top edge of the pear leaf and the abundance of spines, the picking by hand or with tongs is a slow process which would cut down the profits considerably.

The deep magenta color of the fruit juice when evaporated down to a paste makes a beautiful and powerful vegetable coloring matter for use in making colored candies, soft drinks, ices and other products of the confectionery business. This color is doubly valuable because it is not one of the forbidden coal-tar colors. In Old Mexico the natives call the fruits "tunas," and to this day, during the tuna season, they depend almost entirely upon the raw fruits for their subsistence, and at this time they do very little work. Tuna markets are common in our neighbor republic, and at these places are to be found the dried fruits, tuna honey, tuna cheese, and the whole fresh fruits which sell for about one cent each.

Reformed too Soon

A PROMINENT churchman had occasion to visit New York, where he remained for a few days. In writing of his experiences to his

wife in the West he had this to say: "New York is a great city, but I do wish I had come here before I was converted."—*Newark Star.*

Poetry Interpreted

WILLY—Why is it the shades of night are falling fast?

NILLY—Because the girls inside are going to bed.—*Yale Record.*

Hereditary Power

HOAX—"Poor old Henpecke has to mind the baby."

JOAX—"Yes, it's wonderful how that baby takes after its mother."—*Philadelphia Record.*

All in the Family

FIRST FAIR AUTOIST—"Did you have to pay any damages to that man you ran over?"

SECOND FAIR AUTOIST—"No. Fortunately, he was my husband."—*Jewish Ledger.*

A Fixture

"THAT'S a beautiful girl you have in your store," said the man acquaintance. "I've seen her in the window several days as I passed."

"She isn't an employe," the milliner answered wearily. "She's a woman trying to decide on a new hat."—*Buffalo Express.*

Would Do the Right Thing

LADY (to ship captain)—"Please tell my husband what to do if he gets seasick."

CAPTAIN—"Don't worry, madame, if your husband gets seasick he'll do it all right."—*Harvard Lampoon.*

Made Little Noise

"MY ancestors have been in this country for 250 years."

"Gee, but they've been keeping quiet about it."—*Chicago Record Herald.*

Referred to Dr. Sidis

"INFANT prodigies are hard to understand," said the man who is easily imprest.

"I don't think so," replied Miss Cayenne. "As a rule they are simply young people with highly imaginative parents."—*Washington Star.*

The Way to Go

"HE was driven to his grave!"

"Sure he was. Did you expect him to walk there?"—*Pittsburg Observer.*

Mates

BOBBY—"Honest, is there twins at your house?"

TOMMY—"Honest! An' they're just alike."

BOBBY—"Built jest the same way, or are they rights and lefts?"—*Toledo Blade.*

Rapid Heart

LADY PRACTITIONER—When I feel a patient's pulse I generally deduct ten beats. I allow that much for my personality.—*Meggendorfer Blätter.*

True Love

WILLIAM H. CRANE, the actor, says he first learned what true love is by accidentally overhearing a brief conversation between a young man and a very pretty girl. "And you're sure you love me?" said she. "Love you?" echoed the young fellow. "Why, darling, while I was bidding you good-by on the porch last night your dog bit a piece out of the calf of my leg, and I never noticed it till I got home."—*Cosmopolitan.*

An Exception

CALLER—"Is Mrs. Brown at home?"

ARTLESS PARLOR-MAID (smiling confidentially)—"No, ma'am—she really *is* out this afternoon."—*Punch.*

A Landmark

HE—"My dear, I don't want you to wear that dress you had on last night again."

SHE (indifferently)—"What's the matter with it?"

HE—"Er—well, Paddington came up to me and said: 'I can see your wife's back from Paris!'"—*Punch.*

Trustworthy

"RUFUS, you old loafer, do you think it's right to leave your wife at the wash-tub while you pass your time fishing?"

"Yassah, jedge; it's all right. Mah wife don' need any watching. She'll sholy work jes' as hard as if I was dah."—*The Herald and Presbyter.*

Dubious

WHEN Bilkins was away from home on a long business trip he got a letter from his wife that still puzzles him. It ended thus:

"Baby is well, and lots brighter than she used to be. Hoping you are the same, I remain, Your loving wife."—*Cleveland Leader.*

Decaloging It

"WHEN a woman marries and then divorces her husband inside of a week what would you call it?"

"Taking his name in vain."—*Princeton Tiger.*

To Be Sure

WIFEY—"You are drunk, and you said you came straight home!"

HUBBY—"No, I shaid I *buffeted* my way home zhrough the storm."—*The Sphinx.*

Counting the Cost

"SO YOU want to marry my daughter, do you, young man?" "Y-e-s, s-s-i-r." "Well, can you support a family?" "H-how many are there of you, s-sir?"—*St. Louis Star.*

The Cheerful Philosopher

EPICTETUS had listened patiently for hours to the complaints of Brigham Young on the subject of matrimony.

"My chief reason for marrying so often," the latter remarked, "was merely a desire to see if such a thing as perfect connubial bliss existed. 'If at first you don't succeed, try, try again,' was my motto—and I found life very trying. I had thirty or forty mothers-in-law. My milliners' bills ran a close second to the national debt, and I never had a good cook in the house—not once."

"Oh, well," smiled Epictetus, "it might have been worse. Suppose you had forty wives with gowns that hooked up at the back."—*Harper's Weekly.*

Wisdom

IRISHMAN (after waiting at the theatre entrance for a long time on a cold night)—"Shure it's myself wad sooner walk fifty miles than shtand five!"—*Punch.*

In Luck

MR. PENN—"They say the streets in Boston are frightfully crooked?"

MR. HUB—"They are. Why, do you know, when I first went there I could hardly find my way around."

"That must be embarrassing!"

"It is. The first week I was there I wanted

to get rid of an old cat we had, and my wife got me to take it to the river a mile away."

"And you lost the cat all right?"

"Lost nothing! I never would have found my way home if I hadn't followed the cat!"—*Everybody's Magazine.*

ENDLESS BAND RAISES OIL

By

CECIL BEMBRIDGE

GREAT interest in the oil circles is being centered in a new method of raising oil that has been devised by an Austrian engineer, Herr Bruno Leinweber, and is being adopted in the oil fields of Galicia. Gushers here are unknown and resort has to be made to pumping systems to raise the heavy oil to the surface. Moreover the district is very isolated, skilled labor is scarce, and a breakdown in any of the mechanism is serious. It was in order to circumvent these disadvantages as well as to increase the lift of oil, that this Austrian engineer, who has been long identified with the oil industry, evolved his new apparatus.

This system is exceedingly simple both in design and operation. It comprises merely an endless band which is lowered into the borehole, and which in passing through the oil soaks up a certain proportion thereof, which it brings to the surface, and which is squeezed out of the band by being passed between pressing or mangling rollers.

The band, which may consist of ordinary flat hempen rope or steel wire cable, according to the depth of the boreholes—the latter being preferable for deep boreholes—is faced with a carpet shag or pile to increase its absorbent capacity. A great advantage of the system is that when any parts of the rope or pile covering become worn the defective part can be easily cut out and a new section spliced in. Similarly should the band break it is only necessary to make fast to the top end, and then to wind out of the pit by rotating the coiling drum, resplice, and lower, an operation which takes but a very short time.

Upon the Galician oil fields the system has conclusively proved its advantages, simplicity and high efficiency and is now working up to depths of 3,400 feet. Lowering of the band can be very speedily accomplished and a depth of 3,900 feet can be gained in twenty-three and one-half minutes. Moreover the whole plant is complete and it can be erected in the work-shops, transported intact to the oil-fields, erected over the borehole by unskilled labor and set to work in a short time after its arrival. This transportation intact is a prominent feature of the system and marks something new in oil extraction apparatus.

The complete success of the Galician oil fields has prompted other countries to exploit the process. The inventor is now in the Russian oil fields.

OIL POURING FROM THE ROPE AS IT PASSES BETWEEN THE SQUEEZING ROLLERS.

POPULAR · SCIENCE & MECHANICS SUPPLEMENT ·

FASTEST BOAT IN THE WORLD

AN average speed of 42.83 miles an hour was maintained for 1 hour, 26 minutes, 59 2/5 seconds by the motor boat shown in the accompanying photograph in the race of 62 miles for the Cup of Nations at Monaco, off Monte Carlo, last April. She ran with remarkable regularity, winning the race, which was open to all competitors, and proved to be the fastest boat in her class at the annual international motor boat fete. She is named the *Ursula* and is owned by the Duke of Westminster. She was designed purely for racing and is one of the highest powered boats of her size ever built.

THE *URSULA* WINNING THE CUP OF NATIONS AT MONACO.
This motor boat maintained a speed of nearly 43 miles an hour. It is equipped with 800 horse-power engines and is owned by the Duke of Westminster.

The hull is built on torpedo boat lines and is fitted with two Wolseley internal combustion engines of twelve cylinders each. These are mounted side by side forward of the center, and together develop 800 horse-power. When running at speed, the *Ursula* cleaves the water cleanly and turns it back upon itself as the mould-board of a plow turns the soil over.

WRECK OF THE "ZEPPELIN II"

GERMANY'S largest and most powerful military airship was totally wrecked in April in the same manner as

THE *Zeppelin II.* DEMOLISHED BY THE WIND.
The effect of a gale on a leviathan of the air.

two of the earlier ships of the same type. This magnificent greyhound of the air, which last summer made a continuous thirty-eight-hour cross-country flight, is now a shapeless mass of wreckage. The Zeppelin had lain anchored in the open fields at Limburg, where it was compelled to descend after a fruitless effort to return to Cologne from Homburg. As it was being refilled for its ascension a strong gust of wind tore the vessel from its anchorage, whence it swept toward the north, eventually crashing against a rocky promontory. The vessel was a total wreck, machinery and frame being entirely destroyed.

NEW HOEING MACHINE.
Six men doing the work of twelve.

HOEING BY MACHINE

THE man with the hoe is getting to be a back number. Nowadays the up-to-date farmer does his hoeing with such a machine as is shown in the accompanying picture.

The newest machinery for harvesting potatoes not only digs them, but sorts them out incidentally to the process. The time ought surely to arrive before very long when hand labor on the farm will become a thing of the past, all of the work being performed by mechanical contrivances.

SPOTTED BABY THE ONLY ONE OF HIS KIND.
Jane Norica of the Metropolitan Opera Co. christening the young giraffe.

BABY GIRAFFE A RARITY

A BABY giraffe, born in captivity, is one of the features of a menagerie recently seen in Philadelphia. Only once before in zoological history has the stork been known to visit the giraffe family in captivity. In 1854 at the Zoological Gardens in London a baby giraffe was born, but it lived only a few hours. To guard against any mishap the recently born baby giraffe was furnished with no less than three attendants as well as a veterinary surgeon, the four dividing the

day into watches so that a trained expert should always be on duty. In this way the infant with the elongated neck was safely brought through the dangers attending the first few weeks of the life of so delicate a creature. It pays to be careful of the little giraffe, for the commercial value of these animals cannot be estimated, there are none for sale. An offer made by the London Geographical Society of $40,000 for four giraffes now with the Barnum and Bailey show was declined.

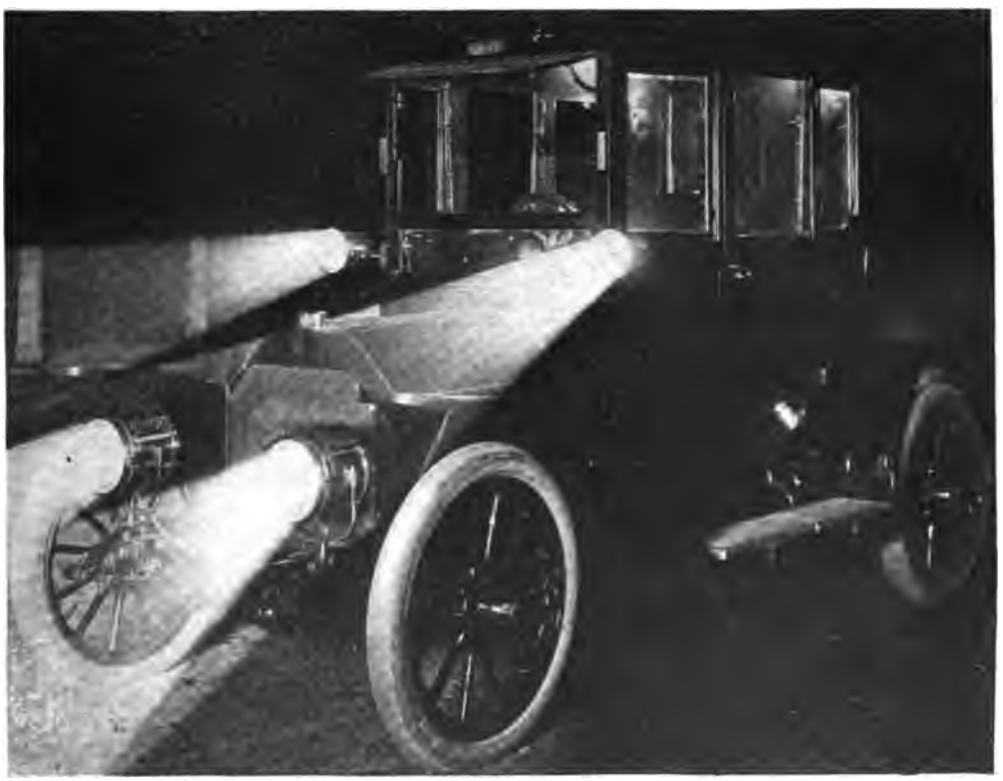
DENVER'S ELECTRIC LIGHT POLES

AMERICAN cities are finally coming to pay much more attention to the appearance of their streets. Particularly is this true in cities of the west. Denver is one of the most progressive in this respect. City ordinances stipulate the maximum height of buildings, and the sky line is uniform for the most part. Trolley and electric wires and electric lights are sustained on ornamental posts or electroliers, which give the business streets the well-kept appearance for which European cities have long been famous.

HELPS MAKE THE "CITY BEAUTIFUL"

ELECTRIC LIGHTS FOR THE AUTO

IN the two years just passed it is estimated that over one thousand accidents, more or less serious in their results, have occurred from explosions of gas



AUTOMOBILE EQUIPPED WITH ELECTRIC LIGHTS.
Illumination is obtained by a small dynamo driven by the engine with a storage battery for reserve.

generating apparatus on automobiles. Because of this, and because of the inconvenience in connection with the maintenance of these generators and lamps, inventors have been busy trying to devise some system by which a practical electric light could be furnished to the automobile.

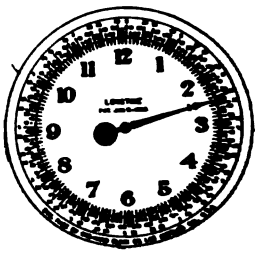
One system consists of a small generator having a positive drive from the automobile engine, a load regulator and a storage battery. The generator running on ball bearings weighs but twenty-four pounds and is capable of producing sufficient current even on slow speed of the engine to light all the regular equipments of lamps and furnish the ignition spark for the engine.

When running on a high speed, or when the engine is running free of the machine, the load regulator comes into play, and diverts the excess current generated into the storage battery. In this way the battery is at all times charged and able to supply ample current to keep the lights burning when the machine is standing idle.

The generator can be connected to any automobile, through a specially constructed noiseless gearing.

WALKED TO FAME.
Edward Payson Weston on his trans-continental trip.

Clock and watch makers now say, "Well, why didn't I think of that? I've been in the business thirty years and never hit on that idea." The



DIAL OF ONE-HANDED CLOCK.
A single hand indicates hours and minutes.

one-hand clock has not yet been condemned by any. It is cheaper to manufacture as it has fewer works. It is quickly and accurately read, giving railroad time at sight. A child who can count can tell the time by a one-handed clock, while those who can tell the time by the old way average ten years of age. An improved clock dial can be put upon an old clock by replacing the long minute hand on the hour spindle, and the result is a one-hand clock, novel, neat, quickly read and accurate. The photograph shows the inventor surrounded by a dozen types of ordinary clocks which he has changed to one-hand clocks by equipping them with his device.

A ONE-HAND CLOCK

AFTER four hundred years a new and useful invention in clocks has been made. It is a clock with one hand.

ONE-HANDED CLOCKS AND THEIR INVENTOR.
Some of the many clocks to which the single hand has been applied.

RAT SKIN IN TRADE

IT is proposed to make a business in Calcutta of securing and preparing the skins of the brown rat, which is very numerous in that metropolis of India.

It has been found that the skin of this animal is well adapted to a variety of purposes, such as the binding of books, the making of purses, gloves, and other articles. It is stated that already the traffic in this commodity amounts to about $250,000 per year in Great Britain and advertisements have appeared for supplies of skins of the brown rat in lots of 100 to 10,000.

A very profitable industry on this order can be established in Calcutta.

A ROAD IN A TEXAS BANANA PLANTATION.
These plantations present a beautiful vista of light and shade.

BANANAS IN TEXAS

BANANAS are being successfully grown in the extreme southern part of Texas. The raising of this tropical fruit is a new industry for that state, and, while it has not yet passed entirely through the experimental stage, the fact is well established that certain of the more hardy varieties of bananas can be produced in abundant quantities at a minimum amount of labor and cost. These banana plantations present a beautiful vista of lights and shades. The plants are of a luxuriant growth reflecting the richness of the soil. No attempt has as yet been made, it is said, to introduce in Texas the commercial varieties of bananas that are extensively grown in the tropical regions of Mexico and Central America for export to the United States and other countries. It is therefore not yet known whether these marketable bananas are adapted to the soil and climate of southern Texas.

FIRST GERMAN SUSPENDED FERRY

THE first suspended ferry in Germany has been recently designed and installed at Osten, across the River Oste. The clear height of the bridge above the maximum water level is about ninety feet, and the span from one pillar to the other is 240 feet. The ferry completes its journey from one bank to the other in a little over three minutes.

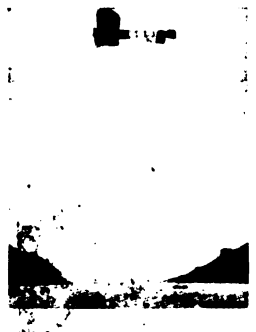
The main advantage of the suspended ferry consists of the fact that the ferry is situated at the height of the surrounding ground. This is why the teams using this means of conveyance do not have to climb any grades, as in the case of elevated bridges and old-style ferries.

FERRY BOAT RUNS ON BRIDGE.
Suspended ferry used to cross the Oste, in Germany.

IMPROVEMENT IN BICYCLES

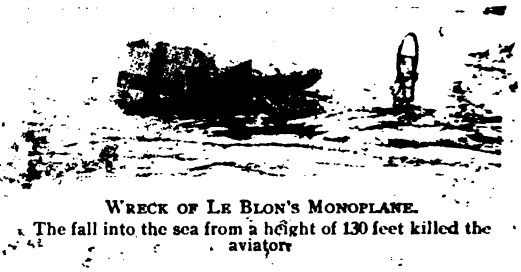
THE accompanying photograph shows a bicycle which, as regards propulsion, is en-

UNIQUE BICYCLE PEDALS.



FATAL AEROPLANE FLIGHT.
M. Le Blon flying over San Sebastian in his monoplane just before it fell.

tirely different from the usual type. The inventor is a technical official in Galizien, Austria, and claims that with this cycle fifty per cent is saved in power or with the same applied force fifty per cent gained in speed.



WRECK OF LE BLON'S MONOPLANE.
The fall into the sea from a height of 130 feet killed the aviator.

A BRITISH AIR-SHIP

ENGLISH inventors have been relatively slow in designing plans for dirigible balloons, but immediately after the Department of War completed the new military airship to be substituted for its unlucky predecessor, Mr. E. T. Willows began a series of most promising tests of a new dirigible of which a description is given in the following:

Mr. Willows has been engaged in constructing and experimenting with steerable balloons ever since the summer of 1905. The first machine was, with the exception of the motor, built entirely in Cardiff. The envelope was made of Japanese silk, 72 feet long, 18 feet in diameter and held 12,000 cubic feet of hydrogen gas. The frame was constructed of steel tubing braced with steel wire, and carried a 7 horse-power two-cylinder gasoline motor driving a two-blade propeller at the rear, and a combined steering and elevating device at the front end of the frame. In all, six ascents were made with this balloon, and much valuable data was obtained from the experiments.

Mr. Willows' latest dirigible, with which he gave some most successful demonstrations at Cardiff in November and December, 1909, is somewhat larger than the earlier models, and carries a much more powerful motor. The envelope in this case is fish-shaped, 83 feet in length and greatest diameter 22 feet, capacity 20,000 cubic feet, and fitted with air balloonnet, two gas valves, air valve and ripping panel. The frame is light and small and built of steel tubing. It carries a 30 horse-power eight-cylinder J. A. P. motor driving two propellers through a clever system of belts and shafting.

NEW BRITISH DIRIGIBLE.
Mr. Willow's lighter-than-air machine.

GLASS MODEL OF THE "SKIPPING SALLY."

CANNON MADE OF GLASS

ONE of the most interesting and novel creations ever attempted in glass is the cannon shown in the accompanying photograph. Two of these were recently made in England. Each cannon with its limber weighs forty pounds and measures twenty-four inches in length, and is made of the finest cut glass. They wheel easily, and the guns move in their trunnions like ordinary cannon. The axletree and bearings are of ornamental brass-work.

These novel cannon can claim to be of some historic interest, as they are models of the gun with which Major General Baden-Powell successfully defended Mafeking in the late Boer War. This celebrated old cannon was dug up at the place during the siege and was the heaviest piece of ordnance that the besieged had. Investigation has since proved that the old gun was cast at an ironworks within ten minutes' walk of the factory where the pair of glass ones were made. The original Mafeking gun was known throughout the siege as "The Lord Nelson" and "Skipping Sally," the officers using the former appellation and the men the latter.

The illustration shows one of the two models with its fine cutting. The elaborate spokes in the wheels give evidence of particularly great care. To carry out the realism, six glass balls are provided.

TRANSMITTER.

RECEIVER.
Original Bell Telephone.

ORIGINAL TALKING MACHINES

PERHAPS the most interesting of all the models of inventions preserved by the government, and now stored in the National Museum at Washington, are those of the original telephone and original phonograph. Nobody could be expected to recognize them. One of the accompanying photos represents the transmitter and receiver of the Bell telephone, patented in 1876. The other is Edison's first talking machine, for which a patent was granted Feb. 19, 1878.

MILITARY AMBULANCE MADE FROM SKI

EVER since ski have become a part of the equipment of the Alpine Regiment of Italy, various suggestions have been put forward to turn the ski to account in time of accident. Up to quite recently these suggestions have been either too complicated or not at all practical. If an accident did happen to the ski, the unfortunate sportsman or mountain climber was helpless in the snow, and his more fortunate companions could render him little assistance.

Our photographs show a patent sledge invented by a member of the Alpine Regiment, who by means of a few light pieces of metal and the help of a pair of ski, an al-

EDISON'S FIRST PHONOGRAPH. MADE IN 1878.

pine-stock, and the regulation military tools, fixed together in a very few minutes an emergency sledge strong enough to carry several people, a most useful expedient in the case of accident or mishap.

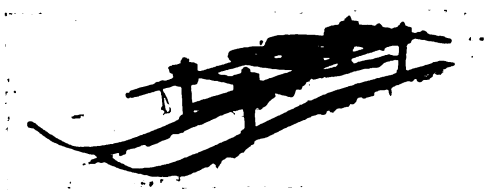
HOUSE BUILDING OF THE WICHITAS

A WICHITA grass house, or "ki," is one of the wonders of western architecture. No one but a genuine Wichita can build one, and the architect and workmen are generally all women!

Some people have erroneously supposed that these houses are built of sod closely packed about a framework of poles and withes. No dirt whatever enters into the construction of a "ki." The tall bunch grass of the prairies is the kind used, and always after it is thoroughly dry. First of all a framework is formed of poles and of the soft pliable branches of the green willows that grow along the water courses. The grass is then first bound in bunches by means of slender willow withes, and there is a certain deft twist of the wrist necessary, which no amateur can supply. The builders begin at the bottom and work upward. The bunches of grass are woven into the framework in layers. Each succeeding layer is deftly plaited into the one below. Unlike the tepees of the Kiowas and Comanches, there is little opening for the smoke, only a tiny aperture at the very top, and no windward flap to keep the smoke from driving back into the house.

THE FIRST COVERED LIFE-CAR.

GRASS HOUSE BUILT BY WICHITA INDIANS.



MILITARY AMBULANCE SLEDGE MADE FROM SKI.

CARRYING A WOUNDED SOLDIER ON THE SKI SLEDGE.

THE FIRST LIFE CAR

THIS is a bow view of the first "life car"—one of the most interesting relics now in possession of the government. It is preserved in the National Museum at Washington. In the year 1847 this boat (if such it may be called), built of sheet iron, brought ashore in safety, at Asbury Park, N. J., during a great storm, 201 persons from a wrecked British ship, the "Ayrshire." The people were packed, a score at a time, into the curious contrivance much like sardines in a can, a hatch being fastened down over them, and in this way were hauled ashore by the help of a rope stretched from the beach to the vessel.

Nevertheless, the life car had certain conspicuous disadvantages—notably an absence of adequate provision for ventilation. Hence, in more recent years, it has been replaced in our life-saving service by the breeches buoy—a simple device, descriptively named, by which, with the aid of a running tackle, shipwrecked people are brought ashore one at a time, not always comfortably, but with reasonable safety and dispatch.

A life car, such as that illustrated, is different from the ordinary life-boat in that no means for rowing it is provided. The car is attached by rings to a hawser reaching from the ship to the shore and is pulled ashore by ropes attached to either end of the car.

"THE OLD LADY OF THE MOUNTAIN"

MOTHER NATURE often creates and fashions queer things, that, for want of a better name are called "freaks." One of these freaks may be seen on the summit of Mount Tamalpais, Cal. This peak is about fourteen miles northeast of San Francisco—across the bay—and is reached by railway.

The panoramic view from the mountain's summit is one of incomparable beauty. To one side of a broad pathway leading around the summit, and known as the "Promenade of Observation," may be seen "The Old Lady of the Mountain." This consists of the colossal profile of the head and face of a woman, and when seen from just the right angle, is complete in every detail.

GREAT STONE FACE.
Odd rock formation on Mount Tamalpais.

MINING ZINC FROM OPEN PITS

OPEN pit mining in the Missouri-Kansas-Oklahoma district is the result of the early day abuses of the royalty system of the land owners, the high royalties charged making it possible for the miners to produce at a profit only the exceptionally rich ore. Unable to mine scientifically because of the excessive charge, the operators, in gouging out the choice deposits, left the ground in an unsafe condition, and throughout the district hundreds of cave-ins may be seen, the surface having fallen in and left unsightly, yawning chasms on every hand. In order to mine the zinc and lead ores still existing in the caved-in areas it has been necessary to resort to daylight operations, as the work has been termed; that is, the land to be mined is stripped and the open pit carried down to the ore deposits.

In the accompanying illustration is seen the Bradford-Kansas City daylight mine, one of the largest of the kind in the district. The stages of development through which this property passed prior to caving in a number of years ago are similar to those of scores of other mineral leases throughout the zinc and lead belt. The royalty charged was high. In order to reap a profit the early operators were forced to produce only the richest of the ore runs; they opened wide, high drifts, leaving no supporting pillars, because such a course would have meant loss of valuable ore. When the ground finally went down, it carried with it a large concentrating plant and swallowed numerous smaller buildings. This debris since has been cleared away. The royalty has been reduced, and with this reduction of

CONVEYOR FOR BRICK LOADING.
Application of a useful invention for the saving of much brick handling.

royalty it has been possible for the new company to open the old workings and handle the dirt at a profit which previously could not have been considered as a milling possibility. This pit is 150 feet in depth, with a diameter of 200 feet.

The bottom of the pit is reached by way of an inclined tramway, leading down from the concentrating plant and connecting with a vertical shaft of framework which goes to the bottom, and through which a large hoisting car is operated. From the frowning edge of the dizzy chasm, a bird's eye view of the old, as well as the new, methods of operation can be seen. Opening onto the sheer sides of the enormous cave are numerous small, doorlike tunnels, ranging in depth from a few feet below the surface to within fifty feet of the bottom of the pit, and telling mutely the story of the early quests for mineral. Each opening represents a drift. They run in every conceivable direction and some are barely large enough for a man to walk through.

The deeper deposits of today cannot be compared in richness with the shallow formations formerly mined. Deep mines in which the dirt contains barely two per cent ore are developed successfully.

BEAUTIFYING A TELEGRAPH POLE.
Californian's idea of garlanding that is worth while.

OLD SPANISH BLOCK-HOUSE AT EL CANEY

DURING the attack by the Americans upon the fort crowning the knoll to the southeast of the town of El Caney, a raking fire was poured into the ranks at right angles by the Spanish soldiers in block-houses situated to the left and right of the attacking lines.

These block-houses, built of heavy timbers, with roofs of tiling, and generally erected upon a lower story of stone or of *adobe* (sun baked) brick, were among the very earliest style of fortifications erected by the Spaniards in Cuba. They dotted the island in every direction and many of them are still standing. Some of these block-houses had not only the loop-holes for musketry, but also embrasures for cannon. Usually the upper story overhung the lower, with loop-holes at such an angle that a perpendicular fire could be directed upon the enemy at close range.

The Spanish block-houses in rural sections were often used as prisons for the unfortunate Cubans, and many were the heart-rending scenes that took place within them during the horrors of the old reconcentrado days.

HUGE OPEN ZINC MINE.
So-called "daylight" mine, from which a rich product has been taken.

OLD SPANISH BLOCK HOUSE.
Used by Spaniards in battle of El Caney.

PETROLEUM STOVE

PETROLEUM STOVE IN USE.

THE two accompanying photographs show a new and very useful petroleum stove, the top of which is arranged like that of a range, different sized rings fitting each other to accommodate small or large pots. Thus the stove can be utilized at the same time for heating as well as cooking purposes, which makes it very valuable for small families or single ladies. When not used for cooking, a pretty cover is placed over the top of the stove giving it an ornamental appearance and concealing its double use.

PETROLEUM STOVE WITH COVER.

A STREET THAT RUNS UP STAIRS

QUEBEC, Canada, has one of the queerest streets in the world. It is a street, too, with an elevator, but one for which the passenger himself furnishes the motive power.

Break-neck Stairs is a locality well known to Canadian tourists; for if the pedestrian reaches the upper town from the lower, by the most direct route, he must go by way of a down-stairs street which terminates in an up-stairs one by means of the aforesaid stationary elevator.

BREAK-NECK STAIRS STREET IN QUEBEC.

Henry Ward Beecher described Quebec as "a small bit of mediaeval Europe perched upon a rock and dried for keeping." Quebec has many quaint and interesting sights, but none more so than this street, which climbs up along the walls of the houses past the second and even the third stories.

RUSSIAN SUBMARINE

UNDOUBTEDLY the Russian flotilla of submarine boats presents the greatest variety of design of any country in the world. Almost every class of submersible has been tested by that nation before settling upon a definite under-water weapon. The Russian flotilla includes a number of Holland and Lake submarines, together with several diving boats constructed at the Krupp yard at Kiel.

The first Russian submersible from the Germania yard at Kiel was the 17-ton submarine *Forelj*, shown below.

SEVENTEEN-TON RUSSIAN SUBMERSIBLE TORPEDO BOAT "*FORELJ*."

THE AUTOMOBILE CLOCK.

CLOCK ON WHEELS

A WESTERN locksmith has hit on this unique idea of advertising his business, combining the advantages of an automobile delivery wagon and a town clock. The interior of the clock is hollow, of course, and is used for stowing parcels, and the dial is not merely a painted board but the face of a real clock which keeps accurate time.

FRENCH MACHINE TO TEST AERIAL SURFACES.

TESTS AEROPLANE SURFACES

ALTHOUGH aviators have conquered the air, there still remains the necessity of forming a more intimate acquaintance with this mysterious element.

The air opposes a resistance to the movement of bodies and it is this resistance which permits an airship to fly, therefore it is necessary to determine its exact value.

It is known that the resistance of the air on a surface in motion depends on the velocity of this surface, its inclination and also upon its form and dimensions.

M. Eiffel, of Paris, has constructed a laboratory where he has devised a new method for experiments on a fixed surface, which has proved practical and expeditious.

The entrance to this building is effected somewhat as into a compressed air caisson—by a system of sluice gates. It is important that the current of air which flows in the interior of the laboratory should not be disturbed. This current of air is aspirated by a powerful ventilator in a vast conduit. The picture shows the arrangement of the building, and a series of planes being tested for their lifting action at various speeds as well as for the resistance offered to the air.

A FOOTBALL TANK

THE above photograph might quite truthfully be called a sporting totem pole, as the white figures on this big standpipe represent the most noteworthy football victories of the Rhode Island State College. Formerly, when the Rhode Island team defeated its rivals, the students covered everything in the shape of automobiles, signs, houses, even railway stations and freight cars, in a radius of four miles with the score of the game. The college then had to dispatch another gang of painters to repair the work of the marauders.

TANK RECORDS ATHLETIC VICTORIES.

Finally an agreement was made with the students that they should put up the scores in the most conspicuous place obtainable and be content with that. This was decided on as the standpipe shown, and the figures have been added each time the big tank was painted, with the result that there has been no more promiscuous painting and a better satisfied community. The students, also, are provided with a record of victories.

THE EVOLUTION OF THE CORN PIPE.
The different stages in the process of turning a corn cob into a pipe.

NEW AUTOMOBILE MUD GUARD.

QUEER MEXICAN BARN

A SERIOUS problem to the hot-country farmer is how to preserve his grain crops from the ravages of ants, weevils, and other destructive insects. Corn is the great staple crop of Mexico, and there well-to-do farmers erect large, air-tight store-rooms of masonry. Other farmers follow the example of enterprising American planters, thoroughly drying the corn and freeing it of the germs of decay and the eggs of insects ere storing it away in metal bins. But the poor farmer has no such aid at hand. The picture shows the quaintly constructed bin of one of these small farmers, known as a *cuescomate*. It is crude, but effective. The main portion or body of this miniature barn is composed of thick layers of adobe. Inside and outside is a coating of cement. The roof is compact thatch of straw so interwoven it sheds the rain effectively. The circular bit of masonry surrounding the base is hollowed out and serves as a receptacle for water, a successful barrier to the entrance of insects.

MEXICAN ADOBE GRANARY.

MUD GUARD FOR AUTOS

MOST people who have walked a crowded sidewalk on a wet day have experienced the nuisance caused by a passing vehicle bespattering them with mud and slush. In London, England, the other day, a meeting was held to consider the question and devise some means of combating the evil. Two cars were in evidence outside the hall where the meeting took place, both of them fitted with a new contrivance called the Shrapnel splashguard, with which, it is claimed, the nuisance can be remedied. The apparatus is of wire, not unlike a flexible wire door-mat, and is suspended from the hub of each wheel and reaches to within an eighth of an inch from the ground. An omnibus was fitted with a splashguard, and a white screen erected on a road close to a mud puddle, showed but a few tiny specks, whereas a broad pattern about seven feet high in black and white was produced when the splashguard was removed.

This device is one of the few automobile improvements as acceptable to the pedestrian as to the auto owner.

MAMMOTH TIRE-SETTING MACHINE FOR LOCOMOTIVE TIRES.

LARGE TIRE-SETTING MACHINE

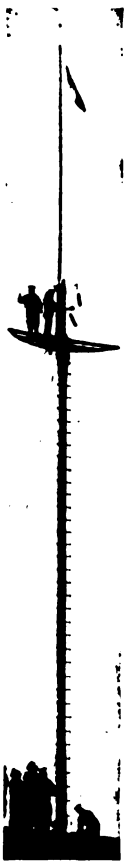
THE illustration on the preceding page shows a unique hydraulic tire setting machine built for use at Buenos Aires, South America, designed for setting tires six inches wide by one and one-half inches thick on wheels from thirty inches to nine feet three inches in diameter. This is one of the largest tire-setting machines ever built.

The illustration gives a good idea as to the extraordinary size of the machine, which measures a little over eleven feet in diameter, exclusive of the pump. This machine is fitted with eighteen hydraulic rams, each capable of exerting a pressure of approximately one hundred tons when a pressure of 2,000 pounds per square inch is applied by the pump.

STRANDED BOAT FOR CHAPEL

ONE of the odd sights of San Pedro, California, is a fair-sized steamboat which stands with its bow overshadowing United States Avenue, the main street of the town, and is flanked on either side by dwellings. This vessel was drawn up on the breakwater and a scaffolding built under the stern to level it up, and the interior has been so reconstructed as to form a chapel, reading room and amusement hall.

As the little village is composed mainly of fishermen, sailors and longshoremen, this kind of structure makes them feel more at ease than would a conventional church building, and the "Bethel" is well attended. The only approach to this strange craft is by a gang plank and, in fact, it has quite the appearance of lying in the dock ready to receive passengers.



BREECHES BUOY IN ACTION.

A BOAT THAT BECAME A CHURCH.

ENGLISH ARMS ON AMERICAN CHURCH

PERHAPS the only church building in America adorned with the English coat of arms, the gift direct of the English sovereign, is old St. James, Goose Creek, sixteen miles from Charleston, S. C. It is one of the oldest church edifices in the South, outside Virginia. It was built in 1703, and is still in use for divine service, as it is in a fine state of preservation.

The pulpit is of the quaint old hour-glass style with heavy sounding-board. Above it is the royal coat of arms of England, in colors as clear as though painted yesterday, the gift of Queen Anne to the colonists in 1704. The lion and the unicorn are of goodly size, and there is no question as to the strenuosity of the wrestling match into which they have entered for the possession of the crown. During the Revolutionary War a detachment of British soldiers was about to apply the torch to the building, when a view of the interior revealing to them the mark of the Queen's favor, the edifice was spared. Thus to the good Queen Anne we owe this relic of pre-revolutionary times.

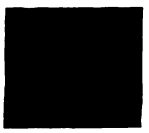
OLD CHURCH BEARING ENGLISH COAT OF ARMS.

TO USE THE TIDES FOR POWER.

NEW TIDE MOTOR

A MOTOR to harness the restless tides, and cause old ocean to make the wheels of the world go 'round is the dream George C. Hale expects to soon see realized.

The accompanying engravings give two views of his model wave motor. One shows it closed, after receiving the impact of the waves, and the other shows the bulkhead device after it had been opened by the receding water, ready to receive the force of the next wave and through the closing of the gates communicate motion to the upright rods. These rods are connected with air pumps above the water line. As the gates open and close the rods turn, and by means of their eccentric connection operate the air pumps, which compress the air into tanks, for use as needed. The model here shown was placed in the water of Santa Monica Bay, where the waves operated it with considerable success, storing air that was used in blowing a whistle and operating a small engine. Piers are to be built for the erection of a working plant.



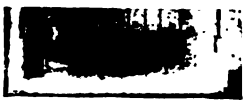
DRIVING A NAIL IN THE WALL.

MOTORCYCLE WITH SHAFT DRIVE AND TWO-SPEED GEAR.

Hale has no stock for sale and is developing the enterprise without any thought of gain beyond that which may result from the success of his motor as a solution of the power problem.

MEXICAN MUMMY HALL

GUANAJAUTO, Mexico, is one of the most densely populated cities of the world. The people live like sardines in a box, literally packed in layers one atop of the other. Where one man's roof tree ends another man's door step begins. The houses cling in tiers to the mountain sides like pigeon boxes along the roof of a barn.



TIDE MOTOR CLOSED.

As there is little space for the living, it may readily be supposed that there is still less for the dead. The *panteon* (cemetery) of Guanajuato is one of the show places of Mexico. In many of the graves the bodies lie three and four thick, one on top of the other. In the walls surrounding the cemetery are thousands more, each body stored away in a narrow aperture resembling a deep pigeon hole. There are seven rows of these pigeon holes running the entire extent of the walls.

HINTS FOR NAILING

IN order to avoid the danger of spoiling good wall paper, when driving in a nail it is well to make two cuts with a sharp knife crosswise in the wall paper, so that the middle of the cross comes where the nail is to go. Then carefully loosen the flaps of the wall paper, drive in the nail and replace the paper with paste, using a soft cloth to smooth it.

If you want to hammer a nail into the

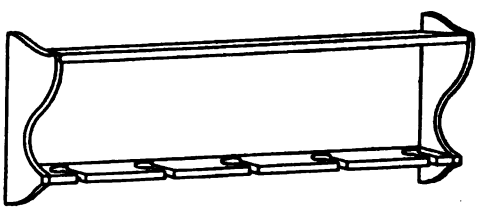
MEXICAN CEMETERY.
Graves are holes in the wall.

wall, where another one has left a big hole in the plaster, fill the opening closely with a mixture of cotton and glue, or collodium, drive in the nail and allow to harden.

When wishing to pull a nail out of the wall, do not press the pliers against the wall, as is the common practice, but twist the nail until it becomes a little loose, and then pull out.

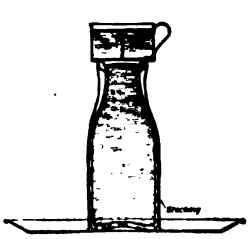
MAKING A PIPE RACK

A CONSTANT pipe-smoker who possesses many pipes gives the following brief description of how to make a rack to keep them in. He sends the accompanying drawings, which show the various parts in section and together.



THE PIPE RACK COMPLETE.

The upper half may be built wide enough to hold the tobacco jar, match safe, etc. The dimensions of the rack are, for the upper shelf, a length of 16½ inches and a width of 5½ inches. The dimensions of the lower shelf and the brackets are indicated in the drawing. The lower shelf is 2½ inches wide by 16½ inches long with five 1 inch holes placed ½ inch from the outside edge. The two shelves are 8¾ inches high by 5 inches long. The material is all ⅝ inch in thickness. The rack may be made of oak, pine, maple or mahogany, as desired.



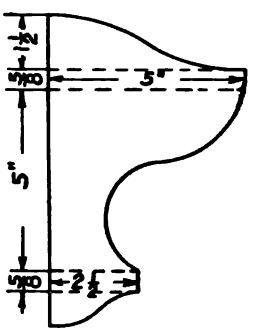
KEEPING MILK COOL.

A pipe rack made like this one will be a comfort not only to the smoker but to his wife, who will no longer find pipes in unexpected corners of the house.

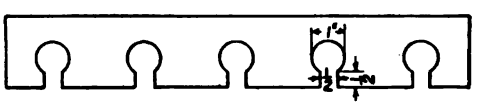
KEEPING MILK BOTTLE COOL

BOTTLES of milk or other liquids may be kept reasonably cool in summer without ice by following the directions given below.

Cut a slot across the bottom of a tin cup. Cut off the foot of an old stocking or the sleeve of an undershirt and pull the small end into the slot. The other end should be drawn over the bottle, the cup resting on the top. The bottle should be placed in a pan, as shown in the accompanying illustration. The cup is filled with water and enough flows down through the cloth to keep the liquid in the bottle cool enough to prevent the contents spoiling. The cooling effect is due to the rapid evaporation of the water in the cloth.



THE BRACKET FOR PIPE RACK.



THE SHELF FOR PIPE RACK.

HINT FOR A HOUSEHOLDER

A CLEVER way to remove a stubborn screw from a piece of wood—a screw that sticks—is to try this recipe: Heat a poker red-hot, and hold it against the screw-head for a little while; wait a few minutes for the screw to cool down, when it will be found that the screw can be removed quite easily with the same screw-driver that just previously would not perform the work. The explanation is quite simple. The red-hot poker heats the screw; the screw expands and makes the hole it is in just a bit bigger. The screw then cools down and resumes its original size, leaving the hole in the wood a size too large—and there you are.

REMOVING A STUBBORN SCREW.

RAPID PRINTING WINDOW

EVERY amateur photographer is aware of the care that must be taken against fogging developing papers when printing in the daytime. A simple arrangement for this purpose is illustrated herewith. It gives plenty of light for changing negatives and prints and does away with any chance of the paper becoming light-struck, besides insuring very rapid work and uniform results.

The apparatus consists of a box about 2 feet high and 2 feet deep and as wide as the window. The top of the box has an opening the same size as the printing frame. A mirror is fitted across the rear lower edge of the box (as shown in Fig. 2) at an angle of about 45° to throw the light from the window directly upon the printing frame. Just below the top of the box there is a shutter of

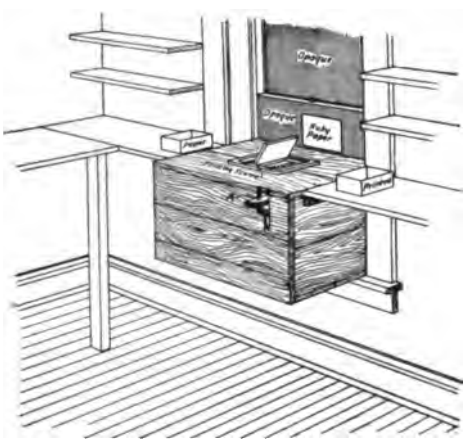
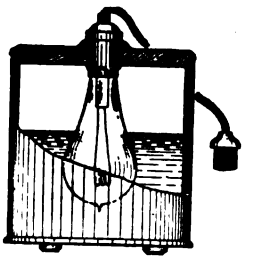


FIG. 1. WINDOW ARRANGED TO PRINT MANY PHOTOS IN SHORT TIME.

½-inch stuff about 1½ inches larger than the opening in the box. The shutter is secured to the top of the box by hinges. An arm is fastened to the under side of the shutter and extends through an opening in the back of the box, as shown at A, Fig. 1. The shutter is held normally against the top of the box by a coiled spring as shown in the illustration. The shutter has an opening slightly larger than the printing frame, fitted with glass, and covered with ruby paper, and so placed as to come directly beneath the printing frame. Around the edge of the opening is tacked a strip of felt to act as a cushion.

The upper part of the window is covered with opaque material, with an opening covered with ruby paper.



THE ELECTRIC BOILER.

When changing the negative or paper, ruby light comes from below through the shutter and from above through the window. To expose the print, the end of the shutter at the back is raised, lowering the front part, and allowing light to strike the printing frame. After sufficient exposure, the shutter is released and it closes. The lower part of the window should be covered with a white sheet to diffuse the light, but if a north window is used this is unnecessary.

ELECTRIC EGG-BOILER

ELECTRIC kitchen utensils are not used as much as they would be were it not for their high purchase price. Several different utensils can, however, be easily made at home. One of these is a small boiler for boiling eggs or for boiling water for tea or other purposes.

The first requisite is a round tin can about eight or nine inches high and six inches in diameter. The bottom and outside should be shellaced and then covered with thick felt before the shellac dries. The felt is then wound with a layer of insulating tape and the bottom covered with a thin piece of wood or heavy cardboard. The whole is then given several coats of shellac. The cover is made of wood, as shown in the sketch, and has a hole in its center to fit a weather proof lamp socket. A smaller hole is bored in the cover to let the steam

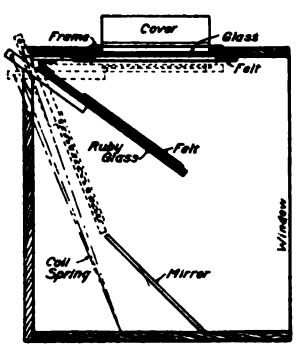
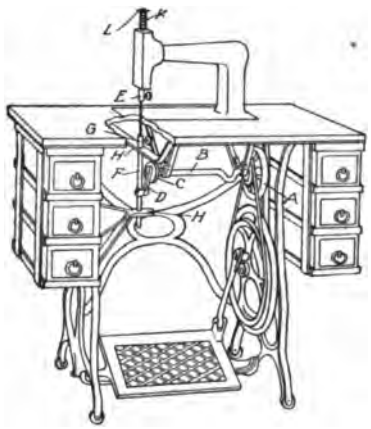


FIG. 2 SECTIONAL VIEW OF RAPID PRINTING WINDOW.

escape. The socket is connected by a lamp cord to a screw plug. A thirty-two candle power carbon lamp is



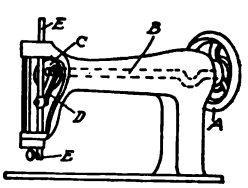
THE SEWING MACHINE CHANGED TO A SCROLL SAW.

screwed into the lamp socket to extend into the can. This completes the boiler and all that is necessary to have water boiling in a few moments is to put it in the can, put on the cover and connect to the closest lamp socket.

SCROLL SAW FROM SEWING MACHINE

THE accompanying sketches show the details and assembled view of a novel use to which a discarded sewing machine was put. The writer found himself in need of a foot-power scroll saw and hit upon the plan outlined below. The results exceeded his expectations, as he found that the machine could be used as a saw for light metal as well.

As it is necessary that the pull should be downward in the cutting stroke, the power had to be below the table. This was accomplished by removing the driven pulley (A) and shaft (B) from the arm of the machine and supporting it below the table so that the driven pulley was immediately above the driver. The shaft hangers



WORKING HEAD ARRANGED FOR SAW.

were made of ¼ inch strap iron bent at right angles with rings of the same sized strap iron welded in the angle. The hangers were bolted to the under side of the table. The crank (C) was mounted on the shaft as before. The connecting rod (D) was removed from the needle bar (E) and mounted on the crank pin. A ⅜ inch rod (F) 12 inches in length was slotted and drilled at (G) to hold the saw, and set to slide up and down in the guides (H, H), which were clamped to the legs and bed of the machine. The connecting rod is provided with a clamp which fitted the rod. The needle bar (E) was slotted at its lower end to receive the saw and, like the other rod, was drilled for a set screw to hold it. The upper end of the needle bar had a coiled spring (K) slipped over it to keep the tension in the saw. The spring was held in place by a pin (L) through a hole in the upper end of the needle bar.

FIRELESS COOKER. SECTIONAL VIEW.

FIRELESS COOKER

AN efficient fireless cooker can be made in the following way:

Make a box out of inch boards 12 inches square and 16 inches deep, outside dimensions. Line the inside with heavy paper and pack newspapers in the bottom to a depth of 3½ inches. Cover this with a false bottom of ½-inch pine. Make a tin or zinc cylinder 7 inches in diameter and 7 inches high, tacking it to the false bottom. Fill the space between the cylinder and the outside with sawdust and cover with a ½-inch board in which a hole is cut to fit the cylinder. Tack the upper end of the cylinder to this board. A hinged lid of 1-inch pine must be provided, with a latch to keep it tightly closed. The only other parts required are a graniteware pail 6½ by 6 inches in size, and a cushion that will fit in the upper part of the box.

THE PARTING OF THE WAYS.
The stream upon the left flows into the Atlantic, while that on the right flows to the Pacific.

GASOLENE-DRIVEN HOME.
Automobile equipped with bed rooms, kitchen and dining room.

THE GREAT DIVIDE

ONE of the show places which invariably interests eastern tourists in the Rocky Mountains is the place where the waters divide, part flowing to the Pacific and part to the Atlantic. In the accompanying illustration, the stream upon the left flows into the Yellowstone river, which in turn empties into the Missouri, thence into the Mississippi and eventually reaches the Gulf of Mexico and the Atlantic ocean, while the stream to the right flows into a tributary of the Columbia River and eventially finds its way to the Pacific. Another such divide is at Portage, Wis., where one part of a stream joins the Mississippi, the other flowing into the Great Lakes.

AUTOMOBILE WITH BED ROOMS

ALMOST interesting English motor caravan with kitchen and sleeping accommodations is shown in the accompanying illustration as used for touring in British Isles during the summer months.

The average daily run is from fifty to sixty miles, and it has covered about 10,000 miles without a serious accident.

The inside of the van is divided into two compartments, one for a bedroom having four berths arranged two on each side. The other compartment is used as a kitchen with two seats which also may be arranged as berths if necessary. In addition to the stove, a cupboard and a

WHERE COLONEL ROOSEVELT TOOK EXERCISE ON SHIPBOARD.
The gymnasium of the Hamburg-American liner "*KAISERIN AUGUSTE VICTORIA.*"

WAVY EEL.
Back of eel is bent in seven places.

folding table for dining are installed in the car.

This traveling home is lit with electric lights and every comfort of a summer residence is provided, the deck of the van taking the place of the usual veranda of the summer home. All the meals are taken in the van and the owner can defy all sorts of weather for enjoyment and health.

EEL WITH CROOKED BACK

THIS eel caught in the German river Elbe, has a spine that instead of being straight, is curved and bent in seven different places. The only explanation that can be advanced for this freak of nature is, that the eel, when freeing itself from a trap, broke its spine in the different places, and that the fractures knitted in this peculiar way.

A BUFFALO-HORSE RACE.
The finish of a heat in which the buffalo are winning.

BUFFALO AS HORSES

THE buffalo has been always rated as untamable and many scientists have regarded him as one of the most stupid beasts that ever existed. It has remained for Major "Bob" Yokum of Pierre, South Dakota, after five years of effort, to accomplish the wonderful feat of training a pair of buffalo to trot to wagon, and also to do many other remarkable stunts, among them running races.

Major Yokum is a former United States Marshal and is known in the old ranching and cowboy life of the American West from Texas to Oregon. Some years ago, he conceived the whim of experimenting to determine what a buffalo really did know. His trouble and trials with the unwieldy bison were innumerable but he finally did succeed in breaking them to harness and driving.

One of their stunts is to race against horses, and it is amazing that they can distance speedy bronchos. They loath the saddling process, and when the rider mounts them will "buck" in a way to shame a veteran broncho.

BUFFALO TEAM.
These animals are thoroughly domesticated and make better drivers than the average broncho.

ELECTRIC SINGING SIGN

NO longer contented to advertise by brilliantly lighted signs a new scheme is developed by which the flashing on of the letters in an electric sign is accompanied by musical sounds.

SINGING ELECTRIC SIGN.
Attracts attention by sound as well as sight.

The signs consist of a separate cylinder of hard wood covered with sheet brass. Holes are drilled all over the cylinder in which pegs are placed as desired, depending on the tune to be played. When completed the cylinder has the appearance of the cylinder used in the ordinary music box. It is revolved by a small motor and the pegs pick up the hammers which are fastened above a set of orchestra bells or metal xylophone. When the hammers are released they fall, striking the bells and making it possible to play any tune. As the tone sounds, the letters flash on one at a time, going out immediately and giving the letters the appearance of jumping rapidly from one place to another all over the sign. As the last tone of the tune is sounded the whole word, or combination of words, appears, remaining lighted long enough for the observer to read the entire sign.

WHERE NATIONS MEET

INTERNATIONAL BOUNDARY LINE.
Divides United States from Canada.

THE international boundary line between the United States and Canada is being appropriately marked in the Pacific Northwest by stone monuments, and also by a pathway fifty feet wide cut through the forests. In the accompanying photograph the pathway is plainly discernible. The light-haired girl standing to the right of the marker is in British Columbia, while the dark-haired girl to the left of the marker is in the United States. The marker shown is No. 181, which means that there are 180 others between this point, near Boundary, Wash., and the Pacific ocean.

MANICURING ON A LARGE SCALE.
Trimming the toe-nails of an elephant. The nails grow very long in captivity, and trimming them is a good day's work.

MUNICIPAL KISSES

AT Hungerford, in Berkshire, on April 5th, the gold-laced town crier sounded repeated blasts upon John O'Gaunt's carved brass horn to summon the commoners to the annual Hocktide Court and to the accustomed ceremonies connected therewith. Those commoners able to attend repaired with beaming faces to the old town hall. Those whom circumstances prevented were excused according to ancient custom upon payment of a fine of one penny.

The head of the town under its ancient charter is the Constable, who by virtue of his office is also coroner and master of the market. To this office the retiring Constable, Mr. A. E. Allright, was reelected. There were also appointed worthy gentlemen to serve as keepers of the keys of the common coffer. Behind the Constable's chair stood two officers whose important functions are still exercised. These were the "Tutti-men," two gentlemen chosen from among the commoners and qualified by gravity of demeanor and uprightness of character for the onerous duties which they were shortly to be called upon to discharge.

When the business of the court had been concluded the John O'Gaunt horn was sounded, and the two Tutti-men, looking very serious and determined, in spite of the long staves they carried adorned with large posies of early spring flowers, proceeded upon a round of house-to-house visits to exact from the inhabitants the dues to which the court is entitled.

From each householder they were entitled to demand the sum of one penny in respect of each dweller under his roof. From each woman householder in default of this payment they were entitled to exact the forfeit of a decorous kiss.

The youth of Hungerford followed the Tutti-men upon their round with eager and sympathetic enthusiasm. According to law and custom the Tutti-men, while they were entitled to keep for themselves all the kisses they collected, were required to spend all the pennies they received in oranges for distribution among the children.

"HOCKTIDE" AT HUNGERFORD
Nurses being kissed by "Tutti-man."

SAVING LOST FISH.
Whenever the Mississippi River overflows its banks, it leaves behind thousands of temporary ponds full of valuable fish. The United States Fisheries Bureau seins out the fish and ships them in milk cans to stock lakes and streams.

LION CUBS' FOSTER MOTHER

THE accompanying photograph shows a pair of lion cubs, male and female, and their foster mother, an Irish setter. The cubs were born to a lioness in the Eastlake Zoo of Los Angeles, California. The mother had killed a previous pair, and the two cubs shown in the picture were taken from her when only a few days old and given to the dog. The foster mother willingly took up the task of mothering them, nursing them until they were considerably larger than she. The picture shows them when less than three months old. Today they are full grown, and are confined to a cage at the zoo, only a few feet from the one occupied by their real mother.

OF WHAT ARE WE MADE?
Some of the materials of which the human body is composed.

QUEER THINGS IN YOUR MAKE-UP

RATHER odd it seems to know that the human body contains no fewer than four substances which are so inflammable that, in a pure state, they will "go off" by spontaneous combustion.

For instance, there is phosphorus. The body of a person weighing one hundred and twenty pounds contains twenty-two ounces of this substance, which, as every body knows, readily takes fire of its own accord, if exposed to the air. It is combined with lime to make the bones, taking the form of phosphate of lime.

The body of a human being weighing one hundred and twenty pounds contains one and a half ounces of magnesium, two ounces of sodium, and two and a half

DOG ADOPTS LION CUBS.
Irish setter which reared a pair of wild beasts.

ounces of potassium. The first of these, a substance of silvery whiteness, is so readily and fiercely combustible that it has to be kept tightly corked in bottles to prevent it from igniting of its own accord. Sodium will take fire if thrown into water, and so likewise will potassium—the latter with great violence, finally exploding and throwing a shower of sparks into the air.

QUEER MILK ROUTE

AMERICANS who visit Europe are amused to see milk delivered by dog teams. The supply of milk in one city is delivered entirely by dog wagons.

But, if one would see milk handled and delivered by crude and primitive methods, one should go to Cuba or Porto Rico, where the place of the milk wagon is taken by a donkey, across whose patient back the milk cans are slung.

A TAXIMETER METER. Machine for testing taximeters.

KEEPING TAB ON TAXIMETERS

PEOPLE who ride in taxicabs often complain that the taximeter has cheated them. Such contrivances are not invariably accurate, it is true. Whence the advantages of a device for testing them, which has been invented by Col. W. C. Haskell, the official Sealer of Weights and Measures for the District of Columbia.

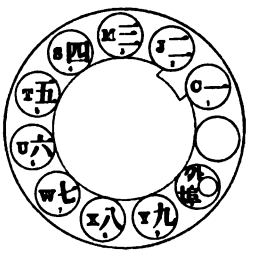
Colonel Haskell believes that his machine is the only one of the kind in existence. An important feature of it is a wheel, the size of a carriage wheel, which is connected by a wire with the taximeter under test. One hundred turns of the wheel represent a quarter of a mile ride by taxicab.

Inasmuch as every taxicab doing business in the District of Columbia is obliged to carry a taximeter that has been duly tested by the Colonel's contrivance, Washington people are able to rely upon an honest fare reckoning.

CUBAN MILKMAN ON HIS ROUNDS.
Milk is delivered in cans slung across the back of a donkey.

TELEPHONE TALKS CHINESE

A FOREIGNER or a person who does not speak plainly often has considerable difficulty in getting a telephone operator to understand correctly the number of the subscriber with whom he wishes to be connected. In automatic systems, a like trouble is experienced by those who cannot read our numerals. The illustration shows a calling number disc for automatic phones used in the Chinese quarter of San Francisco. This disc is equipped with Chinese characters, and the section of the automatic switchboard which serves "Chinatown" is one of the busiest in the exchange.



CHINESE PHONE.
Dial of automatic calling disc used in Chinatown.

OUTDOOR STUDENT COLONY

THE practice that has been inaugurated in some localities of the Northern states of having students pursue their studies in the open air for the physical and mental benefits that it is said to bring to them has been followed on a large scale at the Texas State Agricultural and Mechanical College during the last two terms of that institution.

More than two hundred students at this Texas college live in tents. It was not with the idea of testing any possible health benefits that may come to them, that these students are making their home practically

TENTS WHERE STUDENTS SPENT WINTER.
Many students of the Texas State Agricultural College were forced to sleep in tents dur ing the winter on account of lack of dormitory facilities.

CLOCK OF LAST RESORT.
Naval observatory clock, by which time for the whole nation is computed.

outdoors. The legislature of the state failed to make adequate appropriation for additional dormitory facilities and many of the students had to be placed in tents.

Each tent accommodates two boys, is waterproof, and of strong material. The mental clearness and physical fitness of the student campers are also noticeable. The boys delight in the tent life, notwithstanding the discomforts that they occasionally experience in times of severe weather.

KEEPS TIME FOR THE NATION

THIS clock stands in a vault underground at the Naval Observatory in Washington. It keeps time by the

THREE-WHEELED AUTOMOBILE
Used in Costa Rica, where roads are so rough that ordinary cars are impracticable.

GETTING FORTRESS PLANS BY CAMERA

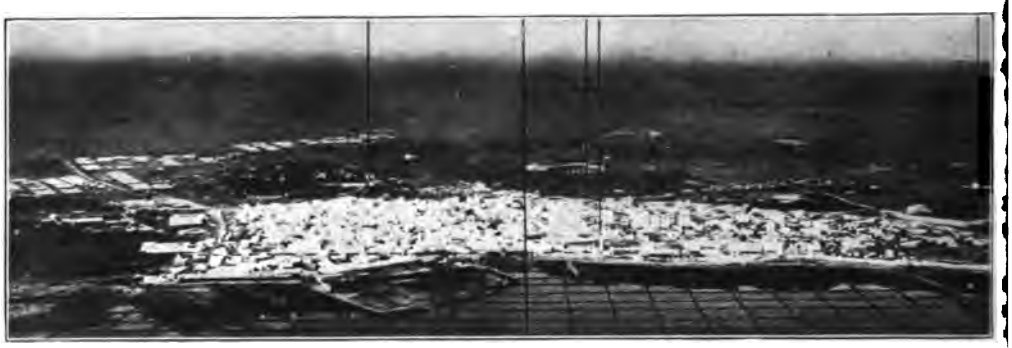
CAPT. SACONNEY, of the French engineer corps, has just invented a device whereby a photographic apparatus eighteen by twenty-four inches is raised by means of kites to heights varying between 300 and 1,300 feet. It gives perfect horizontal photographs which allow the mathematical reconstruction of the plans of fortresses, armed camps, etc. Satisfactory experiments were made by this officer for the secretary of the navy on ships of the squadrons near Morocco and the "Provence."

It was shown that from these photographs correct models of the forts could be made with the dimensions exactly to the scale of the original fortresses.

MOKI COURTSHIP.
Indian maiden brushing lover's hair.

COURTSHIP AND THE HAIRBRUSH

THE accompanying illustration shows pictures illustrating the Moki method of courtship. Among the Indians of that tribe it is customary for the young lady to testify her appreciation of her beau's society by brushing and arranging his hair—the instrument used for the purpose being a bundle of straws. Probably it is intended to indicate by this means that the maiden is not only interested in the appearance of the young man, but is prepared to take up with seriousness the business of waiting on him—which, after all, is the chief duty of an Indian squaw in her domestic relations. Meanwhile his is the arduous task of holding the finished braids of hair.



PHOTOGRAPH TAKEN FROM KITE.
From these photographs the plans can be reconstructed as shown below.

PLANS MADE FROM KITE PHOTO.
These plans were reconstructed from photograph shown above.

MOTORLESS AUTOMOBILES.
Miniature automobiles and their builders.

BOY AUTO BUILDERS

AN enterprising automobile agent out west recently advertised in the paper that cash prizes would be given for the best miniature models of his cars, the condition being that they should be the work of school boys and should be big enough to carry the builder. The result of this announcement brought scores of small boys to the agency and there was a brisk demand for catalogues which contained pictures of the models to be copied.

On the day the prizes were to be awarded about fifteen small boys showed up with their completed automobiles. A brass band was present to play, "See, the Conquering Hero Comes," when the prize-winning machine was wheeled up to receive the praise that was due it.

The capital prize of $25.00 was won by a fourteen year old school boy named Irvin Haynes. It represented a month's work and several dollars' worth of fittings, and was complete in such details as radiator, lamps, "honk-honk," clutches and steering wheel that steered. None of the miniature automobiles were equipped with power but otherwise they were good imitations of the real thing.

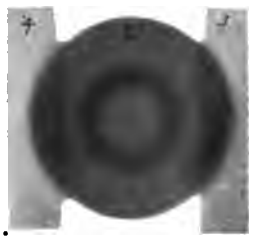
IRRIGATION IN MEXICO

MODERN methods of irrigation are now being practiced in many parts of Mexico, but in some localities the ancient and primitive water-wheel with its human beings for power is still in use. In the more arid parts of that country it is impossible to grow crops without irrigation. The mountain ranges are never far distant, and from them the water supply is abundant and perpetual. This supply finds its way through the

THE PRIZE-WINNING MODEL.
Fourteen-year-old boy and his automobile.

MEXICAN IRRIGATION.
Primitive methods in vogue.

desert regions in clear streams which are the life-giving instruments for many millions of humanity who dwell along their courses. The old-time water wheels have been the means of providing the little fields of corn and other products with the water that is so necessary for their growth. The wheels are very crude, and the water which the small buckets, made of tin cans, bring to the surface and empty into the ditch makes but a small stream. Two native Indians propel the wheel with their feet.



RADIUM PHOTOGRAPH.
Brass ring under copper discs.

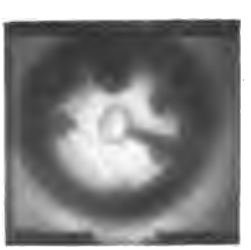
up at the rate of 116 per minute, or a carload a day The stem, the vulnerable point of the orange, is the place at which the wrapping paper is crimped, thus protecting it with a cushion of paper so that it reaches the market in perfect condition. The orange is not only covered, but wrapped so securely that it can stand much rough handling without losing its envelope.

This highly perfected machine does away with the old-fashioned bins and elevators with their bruising drop.

A CALIFORNIA FRUIT PACKING ROOM.
Oranges are wrapped by machine in background.

HUMAN FINGERS OUTDONE

A MACHINE that seems destined to add millions of dollars to the orange industry is now in operation in Southern California. It is designed to replace the old-fashioned method of wrapping oranges by hand and it not only cuts the price of orange packing in two, but does the work in exceedingly short time and without damage to the fruit from careless handling. The machine cuts and prints the tissue paper wrapper, seizes the orange in its fingers of iron and wraps it stem side



RADIOGRAPH OF KEY.
A key and some pins in a tin box required sixty hours' exposure.

PHOTOGRAPHING WITH RADIUM

SOME strikingly interesting experiments concerning the photographic possibilities of radium have been carried out by an English investigator. The radiographs are very clear and distinct, closely resembling those obtained with X-rays, but if anything more defined. Two such radiographs are shown herewith. One required eighty-four hours exposure. With specially prepared X-Ray plates the time would be much reduced

A TRANSPARENT WALL.
To allow plants on north side to get full benefit of the sun.

TIGER-SPEARING IN JAVA

TIGER-SPEARING, a sport handed down from the old Hindu age, and still practiced in certain parts of the Isle of Java, is an atrocity that equals in every respect the Spanish bull fight. It takes place on certain days of the year, especially on New Year's Day, on the estates of native princes, and is still in vogue in the eastern part of Java.

The more beasts killed, the greater is the event, and generally from ten to twenty tigers or panthers, if not enough of the former have been caught, are slaughtered. The animals are confined in individual cages and are placed in the center of a large square, hedged in by natives carrying spears.

The animals are released one by one from their cages by the pulling of a cord, and when they try to break through the human wall to liberty they are caught on the lances, sometimes killed at once, more often after receiving many stabs.

A GLASS GARDEN WALL

WHEN a garden wall is built to face the south, the north side is of less value. A method of using transparent walls has lately been tried, substituting glass for masonry. The rays of the sun filter through so that the trees on the north side yield fine fruit.

As shown by the photograph, the wall has a glass roof projecting over each side. This experiment was made by planting on each side vines, apple trees, peach trees, and different kinds of pear trees. In order to facilitate the comparison it was arranged so that the same varieties corresponded on the north and

IMPROVES THE FIGURE BY ELECTRICITY.
Chicago woman claims to be able to enlarge or reduce any portion of the body desired.

SPEARING TIGERS.
Part of New Year's celebration in Java.

PALM GROWS THROUGH PORCH.

south sides. These trees produced fine fruit, one could not distinguish any difference between them.

HOUSE BUILT ROUND A PALM

IN some parts of Los Angeles there are to be found solitary palm trees of many years' growth which formerly stood in the gardens of old-fashioned mansions. As these homes were torn down to make way for the blocks of modern bungalows it was found necessary to destroy the stately trees, but the illustration shows how one builder solved the problem of retaining this ornament to his lot by simply building his house around the old palm tree.

THE DIVER.
Suit worn by deep sea divers.

MYSTERY OF THE GIANTS

THE mystery of the stone giants on Easter Island —a lonely patch of terra firma in the midst of the wide Pacific—is not likely ever to be solved. Some of the giants are as much as forty feet high, and they were originally placed on huge platforms along the coast, in rows, looking out to sea.

Thus they stood not much over a century ago, though what they represented, whether gods or mere human personages, nobody knows. But there is no question of the fact that the people of the island were ferocious cannibals, and two opposing factions seem to have tried to wipe each other out, and eat each other up. Incidentally to the war, the island was all but depopulated, and the images were thrown down.

STONE GIANT.
Easter Island sculpture.

Not one of them stands today as originally it stood—save a number which, in a partly finished state, remain where they are quarried out from the crater of a near-by volcano. The image shown in the accompanying photograph wears a crown of red volcanic tufa.

STEAMERS ON THE JOHN'S RIVER, FLORIDA, BLOCKADED BY HYACINTHS.
They grow so rapidly that it is almost impossible to clear a path through them.

NOVEL ENGLISH AMBULANCE

THE accompanying illustration shows a unique equipment of an ambulance recently put in service in England. It will be noted that both stretchers are provided with wheels, the bottom one being equipped with springs and fitted with a spring mattress and designed to run into the ambulance on grooved rails. The top stretcher is suspended from the roof and is fitted with sliding handles, the construction being such that it may be folded up. There is ample room for the attendants with two seats and the usual ambulance equipment.

NEW ENGLISH AMBULANCE.
With upper and lower berth.

MAGIC MEN FROM KOREA

HERE are two little men from Korea. One of them is made of straw. The other is of buckskin, and is mounted on a horse of the same material, stuffed.

They are not playthings. Neither are they idols; yet they possess a religious significance. The buckskin man on the buckskin horse is a powerful fetich. If kept in the house, he frightens away the devils, and incidentally brings good luck.

The little straw man is not made to be kept, but to be thrown away. On the eve of the Korean New Year, a copper coin is put inside of him, and he is cast out into the street. He is supposed to carry with him all the sins committed in the previous twelvemonth by the person who thus deals with him.

KOREAN CHARM.
Straw man brings luck.

POWERFUL FETICH.
Throw him away and the finder assumes your sins.

Along comes a beggar and picks him up, pouching the copper coin, and incidentally assuming all the sins in question. It is a very cheap and easy way to get rid of troubles of the conscience.

ADVERTISING IN CHINA

THE Chinese appear to have a fondness, amounting almost to a veneration, for pictures, and foreign art especially excites their attention, because of its difference to what they are accustomed. The people are especially fascinated by calendars, and they never throw away a well-illustrated one, but always keep it in a prominent place. In supplying advertising calendars for China some attention should be paid to the special tastes or prejudices of the people. One American company made a serious mistake in having used pictures of a dog in its advertising posters. Dogs in China are mostly regarded as street scavengers and are not cherished family pets as in the Occident, and this advertising was anything but profitable.

CONCRETE BLOCKS MADE BY WOMAN.
Mrs. Barrett and her handiwork.

GIANT BAT

THE bats we have in this country are little fellows; the biggest of them doesn't amount to much. That they are entirely harmless goes without saying; and the notion so universally entertained by women to the effect that they are liable to get tangled up in one's back hair is without any basis in fact.

If one would see bats that are bats, one should visit southern Asia and the archipelagoes of the South Seas, where the giant bats are to be found. Many of them have a wing-spread of five feet. They belong to a different genus from the bats we know, and some of them are fruit-eaters. They are timid creatures, however, and in no way dangerous.

MONSTER BAT.
Wings spread five feet from tip to tip.

WOMAN CONCRETE WORKER

MRS. E. M. BARRETT, of Austin, Texas, is an expert manufacturer of concrete building blocks. She is familiar with every detail of the industry and moulded with her own hands the blocks for various buildings. She began the study of the uses to which concrete could be put a few years ago and became so interested in the subject that she took up the manufacture of the building blocks.

NEW USE FOR R. R. AUTOMOBILE

A NEW use has been found for the ordinary railroad track automobile, which makes it of great importance to railroad construction work. The motor of the automobile is connected with suitable machines for drilling holes into ties and for fastening the screw-bolts which hold the rails in place, thus allowing the laying and screwing down of the rails in little time, which formerly was very expensive and tiresome work owing to the lack of proper tools.

THE DIVER

THE profession of the diver is picturesque and profitable, although the element of danger deters many from entering it. Accoutered in their heavy trappings the divers are sent down into river or lake to superintend the laying of bases for concrete piers or coffer dams. The diver works only about three hours a day, and is paid from seven to ten dollars for his services.

MOTOR-DRIVEN RAILWAY CAR.
Carries section gang and does much of their work.

SECTION CAR WITH POWER ATTACHMENT.
Assists in laying track.

TREE HOUSE IN MEXICO

MANY different tribes of Indians inhabit the rural districts of Mexico. Each tribe has its own peculiarities of living. In the extreme Southern part of the country it is not uncommon for the natives to live in trees. They build their houses out of grasses and fiber plants and weave the walls among the limbs of the trees so securely that the strongest wind has no effect upon the aerial dwelling. Most of these tree-houses are in the region where earthquakes are frequently felt, and it is supposed that the chief motive in constructing the homes above ground is to place them out of danger from seismic disturbances. The houses sway with the motion of the tree and earthquakes do them no damage, it is said.

MEXICAN TREE HOUSE.

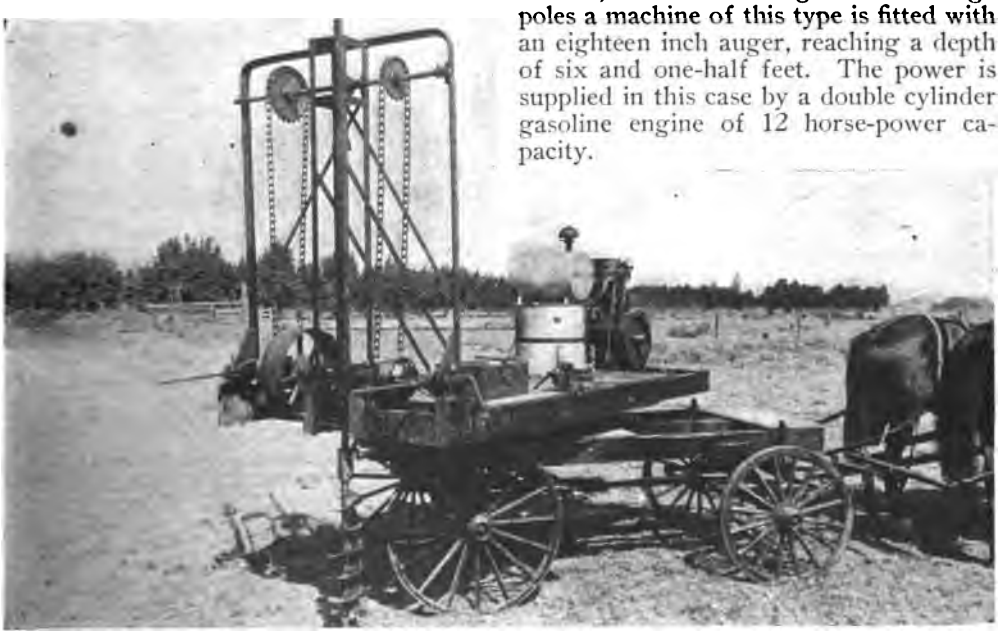
Many of the African savages live in houses built in trees, for protection from wild beasts.

GASOLINE POST-HOLE DIGGER

A UNIQUE gasoline motor-driven earth-boring machine is shown in the accompanying illustration as used in California and the photograph represents it in working position in actual operation at Sacramento.

With one of these machines about twenty-five miles of holes were bored for fencing the right-of-way of the Western Pacific Railroad. The ground was gumbo land with the exception of a short stretch of marsh soil and so hard and dry that every bit of it has to be broken with pick and crowbar when dug by hand. Part of it, in addition to the hard ground, has about twenty-five per cent. small cobble, yet this device bored through all of it and did the work of from twelve to fifteen men.

A vertical engine of the double cylinder type that develops 7½ horse-power is used, while for boring holes for large poles a machine of this type is fitted with an eighteen inch auger, reaching a depth of six and one-half feet. The power is supplied in this case by a double cylinder gasoline engine of 12 horse-power capacity.



GASOLINE ENGINE DIGS POST HOLES.
Motor-driven boring machine for setting fence posts or telephone poles.

BABY CAMEL.
The humps have not yet developed.

RARE BABY CAMEL

THE quadruped population of the New York Zoological Park was enriched recently by the birth of a male Bactrian camel. The newcomer weighs about twenty-five pounds, is about three feet high and three feet long, has two humps and is dull gray in color. At first the infant was barely able to stand on its stilt-like legs, and a robust zephyr would keel it over. It snuggled alongside its mother for support, but it grew strong in about two weeks and scampered around the green with the self-confidence of a messenger boy.

The father is in an adjoining corral and frequently stretches four feet of neck affectionately in the direction of baby camel and mother, but he is not permitted to caress his offspring yet.

The accompanying photograph is the first secured of the baby camel.

CORRUGATED IRON CULVERT.
Used extensively in railroad work.

CORRUGATED IRON CULVERT

THE Pennsylvania railroad has recently made the discovery that many short trestles on their lines are replaceable by corrugated iron culverts. Not only does this save the expense involved in the construction of the wooden trestles but they are fireproof, do not corrode or decay, and give better basing for the tamping in of the roadbed.

On one section of the Pennsylvania Railroad there is not a piece of wood used for nearly twenty miles, the rails being laid on steel ties and the galvanized corrugated iron culverts being used instead of the short trestles in general use. The strength of these culverts is shown in the photograph where a locomotive is over a piece of track under which a four foot culvert has been buried. The culvert is little over a foot under the track yet shows no signs of giving way.

SEVEN THOUSAND SHEEP.
This large flock requires the constant service of half a dozen shepherds.

FOLDING SQUARE

A STEEL square has recently been invented which takes the place of four tools, as it is possible to set and lock it at any angle, giving all mechanical cuts known to the trade, and in this way it serves the purpose of the square, mitre, bevel and try-square. This square also has marked on it a new rule in simplified form, showing all the cuts used in carpenter work and how to get them, thus saving much time and mental work in solving the problems of rafter-cutting, etc.

The greatest advantage of the folding square is its convenience in carrying. To quote the inventor's statement:

"The advantage to the carpenter of such a square will be fully appreciated for the many trials and troubles experienced on account of the railroad and express companies refusing to ship the tool box, with the old rigid square protruding from the chest or when moving from job to job are now things of the past."

"The square problem has been solved by cutting a dovetail of 65 degrees and swinging on a solid steel rivet, butting against dovetail shoulders which lock by two hardened tapered screws. The number of these squares that have been sold and used by the best carpenters, during the past year, has proved beyond the possibility of a doubt that they are absolutely reliable."

FOLDING STEEL SQUARE.

"There are over 2,000,000 squares manufactured annually in the United States of which one million are disposed of yearly to the carpenters and all classes of mechanics in this country, and the balance abroad."

KITE IN SHAPE OF FISH.

This unique square has been on the market for a number of months and is indorsed by practical carpenters. It is the invention of Mr. John Barker of California, who has devised a number of improvements on the old-fashioned carpenter tools and is himself an experienced practical carpenter.

FLOATING DRY DOCK.

FRENCH FLOATING DRY DOCK

THE *Vergniaud*, a French warship of 15,000 tons, is now being built in the dock yards of the Gironde River. In order to complete its construction, which must be accomplished in calm waters, the Gironde Society has built at the side of the launching ways a large floating dry-dock. It is equipped with traveling crane, a masterpiece of lightness and power, enters the deck and moves in a circle on rails. It is capable of raising 140 tons. It is built of reinforced concrete and is 540 feet in length.

A FISH KITE

THIS very beautiful kite was made by a Los Angeles boy and flown in a recent kite-flying contest in which all the schools participated. It was shaped and colored so as to resemble a gorgeous tropical specimen and was undoubtedly the most beautiful entry that competed. The tail was hung in such a way as to seem detached from the kite itself so as to avoid detracting from the appearance of the fish.

There was a great variety in the kites entered, some of them built on the plan of airships, butterflies and other fanciful designs, and ranging in size from a ten-foot monster to a tiny kite no larger than a man's hand.

PRIZES FOR PIGEONS

THE sum of $3,045 is at present offered in prizes for undisturbed nests of the passenger pigeon. This represents a number of subscriptions made for the purpose, the idea in view being to give inducements for the discovery of breeding birds of this species, a few survivors of which are still believed to exist.

John Burroughs, the "good gray naturalist," has offered $100 out of his own pocket for the first nest found in the state of New York. Another prize of $300 will be given by Col. Anthony R. Kuser for a nesting pair of passenger pigeons found anywhere.

It is by no means certain that any passenger pigeons now remain alive in the world. Their flocks, numbering hundreds of millions, were wiped out wholesale by the sportsman and the pot-hunter a generation ago. But there are hopes that few remain. Indeed, it is stated that a flock of about twenty-five was recently seen at Worcester.

The hope is to locate at least one breeding colony of passenger pigeons, make sure that there is no mistake about the species, and organize measures for their protection. The next step will be to start passenger pigeon restoration clubs, and to secure the enactment of laws, with the requisite warden service, so that the birds may feed and breed in safety.

It is proposed to offer rewards for undisturbed nests in each State and in each Canadian Province.

The bird in question was the finest species of pigeon that ever existed. Only a few years ago its flying armies literally darkened the skies, and a single one of its roosts was estimated to have occupants equal numerically to the entire human population of the earth. But it was attacked on its breeding grounds, and subjected to ruthless and wholesale slaughter. Often one man would capture as many as 500 dozen in a single day with a "clap-net," and sometimes the birds were fed to hogs. Trees crowded with their nests were cut down over wide areas for the sake of procuring the young squabs for market.

BRIDGE BUILDING IN CHINA.
Faux-Namty bridge completed.

BRIDGE SPANS CHINESE CHASM.
How the French engineers joined the two halves.

THE FAUX-NAMTY BRIDGE.
Lowering the main members of the bridge into position.

MOTORING BY NIGHT

THERE is a peculiar fascination about motoring at night that is realized to the full only by those who have ridden behind a very powerful equipment of good acetylene headlights and swivel searchlight. The concentration of all the light there is, when driving on a moonless night, upon the narrow ribbon of road directly ahead of the car leaves all the rest of the landscape in total darkness and creates a curious and an almost awesome sense of isolation from the rest of the world. The photograph reproduced herewith was taken in the dead of a black night with no other illumination than that thrown by the lights of an automobile, shows in a striking way how very little the motorist sees at night on a country road. The photograph was taken from the car, whose headlights were directed full upon a white car at the turn of the road while the swivel searchlight was turned to the left upon a black following car, whose lamps show under the illuminated branch of a tree.

HOW THE ROAD LOOKS AT NIGHT.

BUZZARDS OF VERA CRUZ

THIS illustration shows the scavenger, or "Jim Crow" cart, of Vera Cruz, Mexico, going its rounds. This cart is usually accompanied by about two dozen greedy turkey buzzards, or "zopilotes," as they are called. These repulsive birds have a sharp eye for any morsels that may fall from the cart. The cart is peculiar in itself, for though it has but a single pair of shafts, it is usually drawn by two beasts, as is shown here. Vera Cruz in the past has been repeatedly devastated with the terrible scourge of yellow fever. The reason has largely been due to the sewers, which have been above ground. The cleaning of the streets, one of the most important considerations in the keeping down of the plague, has been in the hands of these turkey buzzards, laborers that are patient and industrious, that never go on a strike, and never object in the least to working over hours. The law protects them, and in return they ask for no better quarters than the old cathedral.

WINGED SCAVENGERS OF VERA CRUZ.
A very important part of the city's health department.

MILITARY KITES

ANIMAL OR BIRD?

THE kite which was so long considered a simple plaything, now carries a car with one or two persons. The cellular kite has superseded all other forms. It consists of two or more cells, the various surfaces of which resist the air at different angles. Two rods serve to connect the cells, while the remaining longitudinal rods extend only the length of a cell. These form the corners of the kite and are held in position by diagonal ties which stretch from them to the longer longitudinal rods.

FLYING THE MILITARY KITES.

Hargrave, the inventor of the cellular kite, conceived the idea of using several kites forming a train; he was followed by other experimenters, and it was proved that a train composed of several kites pulls more regularly and has better rising power than a single kite.

In France, Captain Saconney, who has studied the question of surveying land by photography, has succeeded in constructing a man carrying kite, which is very satisfactory. He has been able to ascend with a passenger and 340 pounds of ballast, by moderate winds. The kite which he has adopted is of the cellular type. It is composed of two superposed rectangles forming a biplane with three vertical partitions, each plane is terminated by a small fixed wing. The materials used are canvas and bamboo. When not mounted, the whole weighs about twenty pounds.

MAN-CARRYING KITES.

LITTLE MAMMAL LAYS EGGS

NOT until within very recent years has it been known that there was any species of mammal that laid eggs. Yet there are at least three such in the world. One of them is the "echidna," which is found both in Tasmania and New Guinea. Its eggs look like turtle eggs, and are covered by a tough, white, flexible pod. Presumably they are hatched by the warmth of the parent's body, like the eggs of a hen.

The echidna is nearly related to the Australian duckbill which, with its flat, horny and toothless beak, like that of a duck, its webbed feet, aquatic habits, stout fur-covered body, short tail, and habit of feeding upon insects and worms, seems actually a cross between mammal and bird. It lives in burrows on the banks of streams, like the muskrat, and lays its eggs in a nest built of grass in its tunnel above water mark.

The "porcupine anteater" of Tasmania, likewise lays eggs. This animal is about as big as, and looks somewhat like, the common hedgehog, being covered with sharp spines. It has no teeth and feeds on ants and other insects which it catches by thrusting among them the long tongue.

SOLDIERS PACKING KITES.

ON THE MARCH

ELECTRIC MACHINE WHICH OZONIZES THE CITY.

CANNED MOUNTAIN AIR AT HOME

THE disease-breeding effects of impure air taken into the human lungs are constantly in evidence in mortality records. Sufferers from the many ailments originating in impure air travel thousands of miles to breathe the ozone of the mountains and pine forests. Yet a recent electrical invention enables everyone to have in his home, air constantly as pure, refreshing, and exhilarating as the oxygen-filled atmosphere of the "piney woods" and mountain peaks.

This device is operated by electricity, and can be attached to the ordinary lighting circuit by screwing the plug into a lamp socket, and turned on or off by a switch. When in operation, a silent electric discharge takes place, which "ozonizes" the air of a close room just as an electric storm fills with oxygen the outdoor air. In fact, the silent discharge is merely a series of miniature lightning flashes artificially produced. The illustration shows the apparatus for home use. It measures one foot each way.

PINLESS CLOTHESLINE

DOES the title herald the coming of relief from an old time nuisance? Actually the line requires the use of no clothes pins and yet so perfectly does it hold the garments that the blowing of the wind only serves to tighten its grasp, and tearing is impossible.

NO CLOTHES PINS NEEDED.

The pinless clothes line is made of wire links one foot in length having an eye formed at each end, the two pieces of wire composing the balance of the link laying closely together and being fastened in the middle. In hanging the clothes it is only necessary to grasp a corner, insert it in the eye at the end of the link and draw it in between the two wires until it is firmly held by them.

Among the advantages of the pinless line is the fact that it will hold about one-third more clothing than the ordinary line of the same length for the reason that small pieces can be attached between the ends of larger ones, as is shown in the illustration. In the winter when clothes are frozen or in case of a sudden storm it is unnecessary to remove the clothes from the line before bringing them into the house for by unhooking

SMALL CAR CLIMBS HEAVY GRADE.
Scotch motor car of 15 H. P. climbing a hill in a slate quarry near Loch Lomond.

one end of the line it can be folded up with the clothes and brought into the house in the basket.

The line is galvanized to prevent rust, and while slightly more expensive than the ordinary wire line, when the expense of clothes pins is taken into consideration, and the advantages possessed by the line added, the difference is hardly worth mentioning.

FORTUNES IN ALFALFA

HERE is a picture of alfalfa going to market. It means a lot to the farmer, because alfalfa is the most profitable of all forage crops. It yields three cuttings a year, and, under favorable circumstances, produces eight tons to the acre.

Out in Kansas, alfalfa has paid off the mortgages on thousands of farms. But the alfalfa that does so well there, and in other parts of the West, will not yield satisfactory results in the East. Accordingly, the government Plant Bureau at the present time, in coöperation with the experiment stations of the States, is trying to develop new varieties, suitable for cultivation in the East and South.

QUICKSILVER PLANT.
Obtains mercury from cinnabar.

REDUCING QUICKSILVER

THE method of obtaining the quicksilver from the ore is different from that of smelting other kinds of ore. The process is comparatively simple and consists of subjecting the ore to a heat that causes the quicksilver to free itself in the form of vapor. This vapor is conducted through a series of condensers and causes the fumes to be precipitated in the form of the liquid metal. It then flows into receptacles and is placed in flasks ready for shipment and sale.

TAKING ALFALFA TO MARKET.
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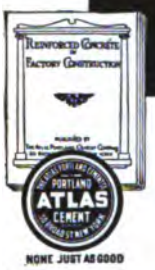

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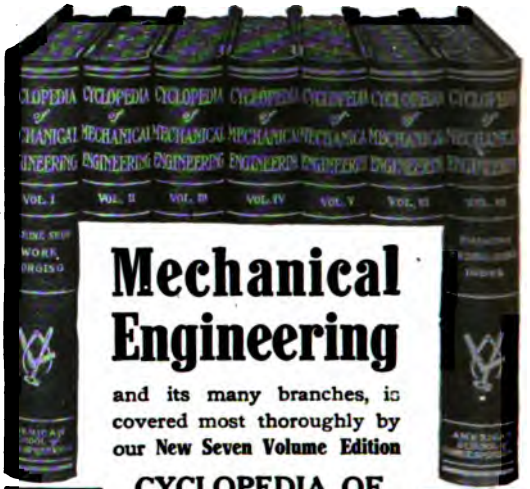

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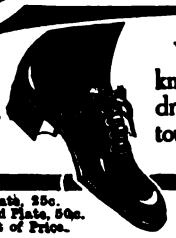

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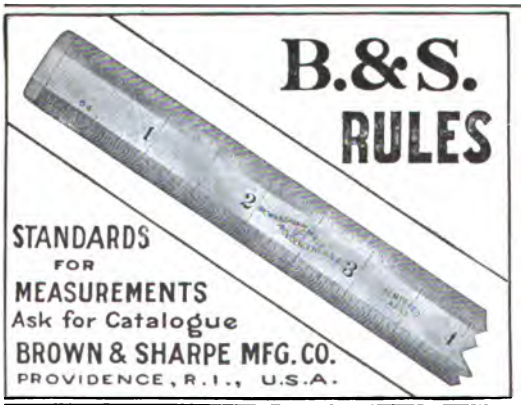

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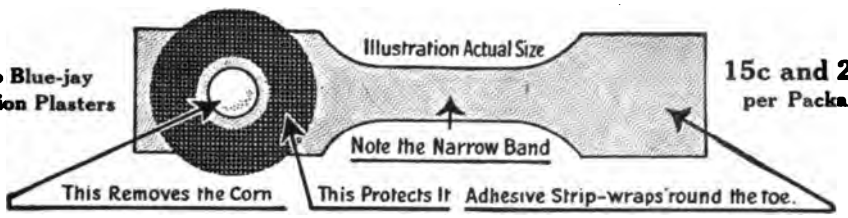

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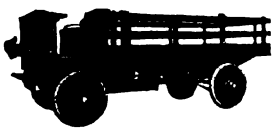

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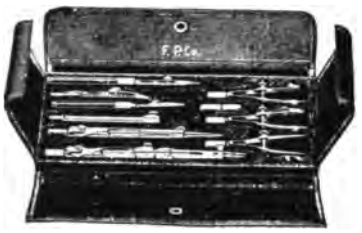

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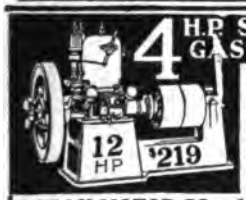

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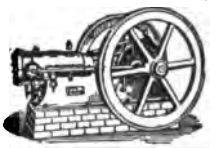

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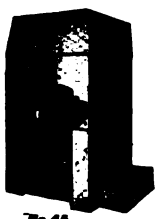

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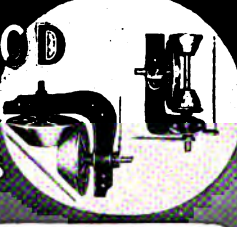

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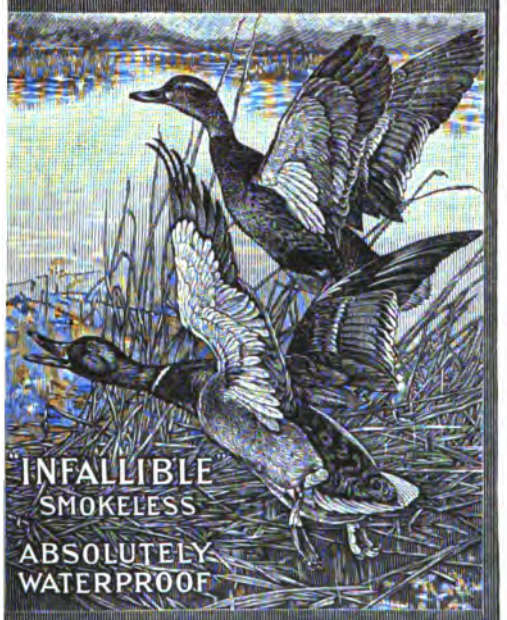

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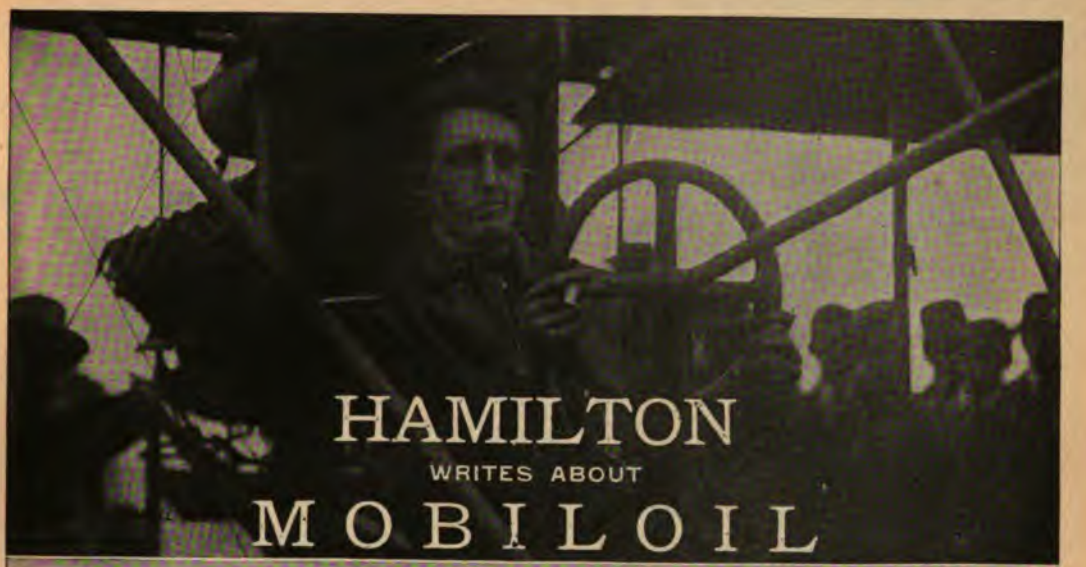

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